BarCharts, Inc.®
WORLD'S #1 QUICK REFERENCE GUIDE
Quick Study® HOME

gardening

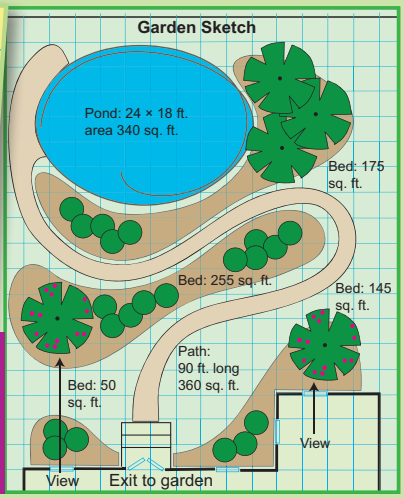
Planning, designing, planting practices, plant categories & uses, sustainability strategies & management

MAKE A PLAN

It is important to think ahead before you tackle your garden project, regardless of whether you have an existing design or are starting from scratch. Here are some things to consider before putting a shovel to the ground:

- **Examine existing conditions.** Get to know your property by studying its physical characteristics and how it is affected by the elements at different times of the day and year (*see* **Assessing Current Conditions**).
- **Create a sketch.** This is the fun part! Measure the area you will be designing, and lay out the geometry on a piece of graph paper. Show where you want to put the elements of your design, and estimate the area of each. Make sure you study how the garden relates to the inside of your house, both visually and spatially.
- **Determine a financial budget.** It's best to know how much you are prepared to spend on your garden. This can be your total allowable investment or a yearly amount that is based on your cash flow, your disposable income, or your property's market value.
- **Create a yearly schedule.** Certain jobs will be assigned seasonally, depending on the local climate and growing season. Taking note of this at the outset will help you establish your design and budgetary priorities.
- **Estimate maintenance.** Be realistic about how much time you want to dedicate to building and maintaining your garden. This will influence both your design and the expense of initial construction.

Item	Area sq. ft.	Cost sq. ft.	Cost subtotal
Planting beds	625	$20	$12,500
Pond	340	$15	5,100
Stone path	360	$18	6,480
Remaining (lawn)	918	$1.75	~1,600
Total	~2,240 sq. ft.		~$25,680
Average cost per sq. ft.: ~$11.50 (All costs are hypothetical)			

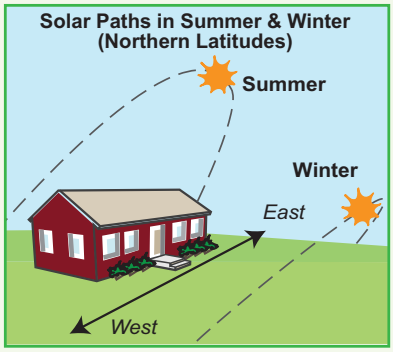


Planning Tip Coordinating design and budget is an ongoing process. Calculating your square footage and dividing your budget by your total square feet will give you an **average cost per square foot budget** that will help you decide on materials and treatments to keep your costs balanced.

ASSESSING CURRENT CONDITIONS

The success of your design and the performance of your garden will be influenced by the opportunities and limitations of site conditions, which can be studied by observation or research:

- Soil **structure** refers to the aggregation of soil particles and the resulting pore spaces created between granules. Native, undisturbed soil has a superior structure to commercial topsoil.
- Soil **texture** refers to the particle types, including gravel (the most coarse), sand, silt, and clay (the most fine). Fine-textured clay is easily compacted and does not drain well. Coarse sand drains well but does not hold organic nutrients well. Loam is the name given to soil with a balanced content of clay, sand, and silt.
- Soil **composition** refers to its organic and mineral content, which will influence the acidity or alkalinity (pH) of the soil. A slightly acidic pH (6–7) makes important soil nutrients more available to plants.
- **Solar exposure** is the result of orientation and shading by structures and trees. It influences plant selection, seed germination, and plant growth. In the summer in the northern latitudes, the sun rises north of true east, sets north of true west, and is higher in the sky at noon. In the winter, the sun rises south of true east, sets south of true west, and is lower in the sky at noon.



Assessment Tip Having a licensed surveyor prepare a map of your property is a great way to study and diagram your site. A survey typically locates property boundaries and shows topographic contour lines, structures, and trees. It's a good investment that enhances the value of your property.

USDA Plant Hardiness Zones by Localities

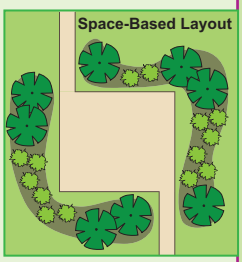
Zone	Location
Zone 1	Fairbanks, AK
Zone 2	Pine Creek, MN
Zone 3	Williston, ND
Zone 4	Helena, MT
Zone 5	Chicago, IL
Zone 6	Rochester, NY
Zone 7	Nashville, TN
Zone 8	Atlanta, GA
Zone 9	Houston, TX
Zone 10	Los Angeles, CA
Zone 11	Miami, FL
Zone 12	Honolulu, HI
Zone 13	San Juan, Puerto Rico

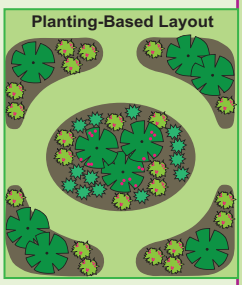
NOTE: All zones have an "a" or "b" designation and are subject to change according to climate trends.

- **USDA Plant Hardiness Zones** are prepared by the U.S. Department of Agriculture and are based on statistics over a range of years. Plant catalog descriptions typically include their range of suitable zones. There are currently 13 zones in the United States, each with an "a" and "b" subzone. Zone 1 is the coldest, and zone 13, with average minimum temperatures between 60°F and 65°F, is only found in Hawaii and Puerto Rico.
- **Available moisture** relates to the variable percolation rates of soils, which indicate how quickly they drain. Sand has a high percolation rate and less moisture content than finer soils. Although clay has a high moisture content, it has low hydraulic conductivity (i.e., water tends to get trapped in clay in between soil layers, weakening its structure and limiting water uptake by plants).
- **Slope** refers to the pitch of the ground, influencing the way water flows, collects, and drains on your site. The degree of slope will dictate the types of plants or other materials you will use in your garden. Water generally accumulates in low, concave areas.
- **Off-site conditions** refer to what's happening next door. The visual quality of neighboring properties, as well as your own desire for privacy, will determine how much screening you need. Don't forget to consider stormwater runoff, fertilizers, or invasive plants that may be migrating onto your property.

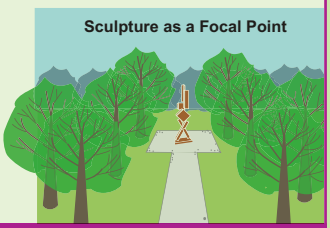
DESIGN TOOLS

Before you start working on the ground, you need to refine your sketch into a measured drawing and lay out all the elements you want to include in your garden. Here are some garden design definitions to help you get started:





- **Space-based layout:** A design that is based on *spaces* for activities, such as lounging and dining, and builds the plantings around those spaces.
- **Planting-based layout:** A design that is based on the creation of *planting beds* and develops the leftover space around these for circulation and gathering.
- **Garden room:** A space enclosed by plants, structures, or both and used for hosting activities, similar to a room inside your house.
- **Planting patch:** Vegetation grouped to create a continuous mass, with a regular or irregular outline. Planting beds are patches, as are groves of trees.
- **Corridor:** A linear space, enclosed or edged, that allows movement along or within the space.
- **Edge:** A continuous element that encloses or defines an area, such as a row of low plants, a fence, or a stone wall.
- **Gateway:** An access point or opening, usually through a barrier such as a hedge, fence, or wall, that serves as an entrance to garden rooms or corridors.
- **Focal point:** A strategically placed item of interest, such as an ornamental plant or a statue, that draws the eye through the design of the surrounding elements.

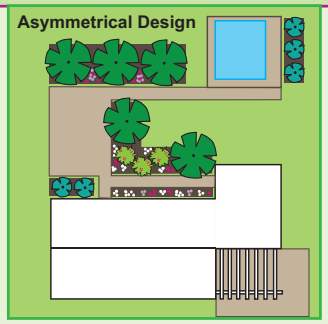


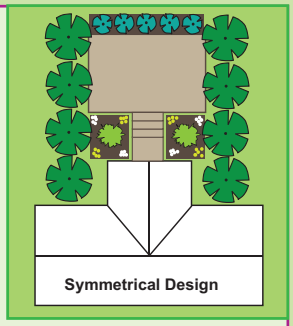
Design Tip Don't make the mistake of making arbitrary shapes on your plan because they look good on paper. Try to imagine how you would experience the design while relaxing, gardening, or moving around.

COMPOSITION

Garden design is an art that depends on your understanding of a composition's visual and experiential qualities. Once you have experimented with the design tools, you can test your layout according to some basic rules, such as hierarchy, repetition, symmetry, balance, tension, and mystery:

- **Hierarchy** is the distinction made between different levels of importance. For example, if you have a main path and two narrower paths, you have established an order that suggests different levels of importance.
- **Repetition** is the placement of an element more than once to create unity or to direct movement, giving rhythm to your design (e.g., paving materials that change at every path intersection).
- **Symmetry** is the balance created through repetition of elements among the parts of a compositional whole. For example, bilateral symmetry is when two spaces are mirror images of one another along a centerline.
- **Balance** is visual stability created by a perceived equality between parts. For example, an asymmetrical garden design may position diverse numbers and sizes of its elements on both sides of a path, but the total effect of the features on each side appears evenly distributed.
- **Tension** is the sensation created when balance is purposely avoided and one or more compositional features seem to be tugging at the viewer's attention. For example, contrasting forms, colors, or textures or unexpected empty space can create visual tension.
- **Mystery** is a form of tension created by hiding things from view (e.g., a large gate that conceals the space beyond, or a path that leads out of sight behind a mass of vegetation).



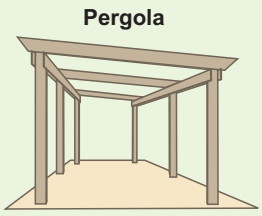


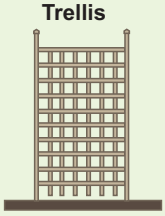
Compositional Tips The best way to understand composition is by looking at books about garden design or by visiting formal gardens in your area that are open to the public. You can't create anything new unless you understand the old. Make sure the design of your garden reflects the times, your region, and the style of your house, rather than the look of a foreign place or era.

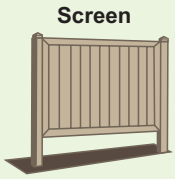
STRUCTURAL FEATURES

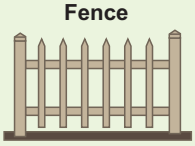
The abstract design of your garden becomes real when you start to detail its functional features according to your plan. The following are typical elements you may want to include:

- **Beds:** Planting beds will be the fundamental element of your garden. Beds require healthy soil, good solar exposure, and water. The size and shape of the bed depends on the size and number of plants desired. When you are designing bed sizes and shapes, make sure all the plants are accessible for pruning and leave some space to walk into the bed if necessary.
- **Raised beds:** When the site's native soil is poor or when you'd like to give some vertical dimension to your garden, raised beds may be the solution. These can be created by mounding or by filling a constructed frame with imported or amended soil (*see* **Planting Practices**, pp. 2–3, for more details).
- **Borders:** A border is a linear type of planting bed that creates an edge or enclosure around a space or along a path or structure. Because borders are narrow, it is usually easy to access all the plants in a border.
- **Naturalized areas:** In the case of large properties or those next to fields or forests, some garden zones can be designed as meadows or woodland edges. Naturalized areas can add character and habitat value to your garden and may require less maintenance than beds once they have been established.
- **Hardscaping:** This refers to surfacing with stone, brick, gravel, or other paving materials to create terraces, patios, and pathways. These materials are best used on level areas for lower construction costs and nearer to the house if they are used for gathering, dining, etc. Stone walls may be used for enclosure or to retain slopes.
- **Architectural structures:** In some cases, screening, shading, and planting in tight spaces can be best achieved with garden features that are more architectural, including:
  - **Pergolas:** Made of columns or posts and beams that create a skeletal structure on which plants are made to climb. Pergolas create shaded spaces adjacent to a house or other building, as well as corridors leading to or connecting outdoor spaces.
  - **Trellises:** Typically vertical, flat structures that need to be anchored to the ground or attached to other structures and are used for climbing plants.
  - **Screens:** Freestanding sections of solid fence, usually higher than eye level, that are used to block unwanted views or to create a backdrop for a special garden feature. Screens can be used in single or multiple sections and protect privacy without occupying much space. They are anchored underground by posts.
  - **Fences:** Generally longer linear structures made of a variety of materials and used to mark property lines, enclose areas to restrain animals, or create a safe space for children to play. Stone walls may be quite low, although most fences tend to be about 4 feet high.
- **Water features:** The availability of water is crucial to every garden, and a variety of water features can be used depending on climate and culture. Fountains and pools may be highly structured, while others may be softer landscape treatments that enhance low-lying areas through grading and planting (*see* **Strategy 4: Conserve Water**, p. 4, for more details).
- **Sculptures:** Three-dimensional artwork that can survive outdoors can add a great deal of aesthetic quality to a garden while performing important functions. A sculpture, whether devotional, inspirational, or purely artistic, can be used as a focal point, as a visual cue marking gateways or spaces, or as the principal feature of a garden. Once a sculpture is introduced into a garden, it becomes a part of the overall composition.
- **Greenhouses and cold frames:** These functional features not only extend the growing season by allowing you to get your plants started early but also are beautiful elements that can be large or small, traditional or modern. Greenhouses can provide a comforting refuge on a cooler, sunny day and protect plants from harsh conditions and animal predators. Cold frames are usually moveable transparent enclosures placed over plants or groups of plants to accelerate their development by increasing temperature and humidity.
- **Work areas and storage:** Potting sheds, tool sheds, and covered or paved work areas can double as screens, enclosures, or focal points. Purchased sheds can be improved through color, added detail, location, and landscaping of the surrounding space.









Structure Tips Your garden will evolve by layering some or all of these structures to support your planting plan and outdoor living spaces. Consider solar exposure, accessibility, and enjoyment. It is likely that you will want many of your features to surround a main focal or gathering space, and they all need to work together to support your design.

PLANT CHARACTERISTICS

Plants are the main feature of your garden. The following plant characteristics need to be considered as you make your selections:

- **Size:** Know the mature size of each plant species you choose so that you can space them properly and understand how they will perform (shading, screening, etc.).
- **Texture:** This refers to fineness of detail. Plants with large leaves look coarse, while tiny-leafed plants are considered fine textured.
- **Color:** Flowers aren't the only part of a plant that contributes to the color composition of your garden. Leaves, stems, and bark also offer an increasing chromatic array.
- **Bloom schedule:** When does each particular plant typically flower? Do you prefer to have plants that flower all at the same time or stagger throughout the growing season for continued interest?
- **Fall color:** If your geographic area enjoys four seasons, autumn leaf color can add drama to your garden. Color performance varies among individuals of a species, so select these trees and shrubs from the nursery in the fall when possible.
- **Winter interest:** Features that add beauty in winter include berries, bright stem or bark color, and evergreen foliage. Dried perennials, and grasses in particular, add texture to the winter landscape.

PLANTING PRACTICES

Once you know the characteristics you'd like your plants to have, it's time to consider the placement of plants in your garden.

- **Move from large to small.** Start by studying any existing trees and how they fit in with your plan. Your design may work around large trees in good condition or may require the removal of poorly sited or diseased trees. Small trees may be relocated in late autumn, and larger trees should be pruned to improve their form and ensure safety. Then decide where smaller trees and large shrubs will be placed, working your way inside to out and down in size from woody plants to perennials, annuals, and groundcover.
- **Inspect plants before buying.** Always buy plants from a reputable source. Visit several nurseries and compare their inventories, not just their catalog photos. Look at the way the plants sit in their pots, and compare the size of the pot to the plant. Examine the branching structure of trees and how much space is allowed between in-ground plants. Leaves should not be dry or wilted and should have good color. There should be no sign of disease or pests.

- **Prepare beds.** There is no universal recipe for plant bed preparation, but each approach should comply with the following criteria:
  - Existing vegetation should be carefully cut and lawns stripped with a sod cutter or dried out by blocking sunlight to minimize soil disturbance. Carefully remove and conserve topsoil.
  - Soil texture should be amended as needed to enhance both water retention and drainage.
    - The native soil should compose the majority of the soil mixture.
    - Organic compost should not be mixed into the soil but rather applied to the surface after planting so that its nutrients can percolate into the soil when it rains.
- **Set the grade.** Planting beds should be either mounded (convex) or depressed (concave) depending on available rainfall, water requirements of plants, and soil drainage. Beds lower than the existing grade are typically used for rain gardens that are meant to collect stormwater and feature appropriate plants. In temperate zones, mounded beds are the rule, as they prevent root systems from becoming waterlogged.
- **Raise beds where needed.** Poor soil or sloping ground may warrant raised beds, which are contained by low frames about 6–8 inches high. The soil surface of the bed is level. Raised beds are typically used for vegetable and herb gardens. The underlying soil may still need amendment, which is usually done when digging out the bed to install the frame of wood or stone.
- **Space plants properly.** Plants should be spaced according to their mature diameter and how close you want them to be. Trees with a 20-foot crown should be spaced 20 feet apart, unless you want their branches to intermingle to create the effect of a hedge or continuous canopy. In that case, trees may be planted at half their mature crown width. Shrubs and perennials follow the same rule.
- **Excavate and plant.** Dig a hole as deep as the root ball and wider. Loosen the walls and floor of the hole with a pitchfork. Mix excavated soil with a texturizer such as commercial manure. Use some of the amended soil to raise the center of the hole. This will allow you to make sure the flared base of the trunk or main stem is clearly above the finished grade of the bed. Remove the plant from its pot, or cut away any wire and burlap.

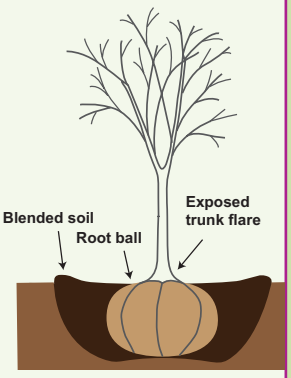
Perennial Spacing Tip Nurseries and plant catalogs provide information on mature plant height and spread. Here's how you can estimate how many plants you will need for your bed:

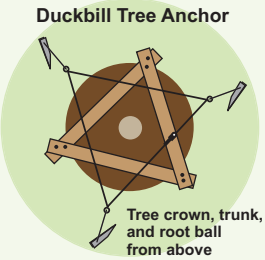
- A square foot is 144 square inches. If the desired perennial spacing is 18 inches, then divide: 144 ÷ (18 × 18) = 144 ÷ 324 = .44
- Multiply your answer by the number of square feet in the bed. If the bed is 5 feet by 10 feet (50 square feet), then you'll need 50 × .44, or 22 plants for the bed.

Soil Prep Tips

- After removing vegetation, existing (native) topsoil (the top 6 inches) should be lifted in blocks with a spade or shovel and carefully set aside and covered while working, in case of rain.
- Dig down farther (to the height of your spade), remove the underlying soil, and mix it with well-rotted manure (up to about one-third) or another texturizer, such as coarse sand (about one-tenth).
- The native soil should be replaced on top, without breaking up the clumps, to preserve its microstructure. Sprinkle more rotted manure between the clumps.
- The use of peat moss to amend soil is not a sustainable practice because it must be mined from endangered landscapes.

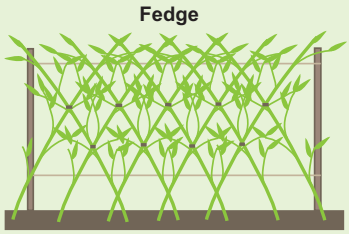
- **Backfill and top-dress.** Place the remaining amended soil around the sides of the root ball once the plant is set at the proper height in the hole. Pack the soil lightly with your feet so that the root ball remains firmly in place and the bed is slightly mounded. Don't overpack, as the roots need some air. To finish, place a couple of inches of ground, seasoned organic compost over the bed's surface, keeping clear of the trunk or stem. *See also* **Management > Mulching,** p. 5.
- **Stake trees.** The practice of staking trees after planting is often used, especially in large-scale commercial projects where it is considered a precaution against upsetting trees while their roots are connecting to the surrounding soil. It is debatable whether holding tree trunks in a rigid position is beneficial. If a site is exposed to strong winds, a duckbill anchor that holds the root ball in place without limiting movement of the trunk may be used temporarily (for about 1 month).
- **Water.** Slowly water the adjacent soil after the tree has been planted until it is thoroughly soaked. Then give the soil the opportunity to dry before repeating. Depending on the soil type and climate, this may be between 2 and 5 days. Watering may be minimized if planting is done in the spring or fall when there is more rainfall and less evaporation. Check the soil, and do not overwater.





PLANT CATEGORIES & USES

- **Trees** range in size from small (15–25 feet) to large (over 50 feet). Mature size is important to consider when including trees in your garden. Characteristics such as branching pattern, bark color and texture, fall color, and winter interest will contribute to the effect of a tree in its particular setting. Trees are landscape sculptures that also provide important functions such as shade, wind screening, and habitat.
- **Shrubs** don't provide an overhead canopy like trees do, but they do create wall-like enclosures. Large shrubs (8–12 feet high) are more easily maintained than trees. Along with texture, branching, fall color, and fruit, shrubs may feature showy flowers and attract songbirds. Used in small groupings or rows, they create strong forms that define the spaces of your garden. Low, spreading shrubs (1–2 feet high) can be used as effective, rich groundcover, protecting soil from moisture loss and erosion.
- **Hedges** are composed of shrubs or small trees that are usually aligned along a border and pruned for form. Certain plants are better suited for the creation of hedges due to their posture and growing patterns. **Fedges** (which get their name because they are a cross between a fence and a hedge) are created from easily pruned, quick-sprouting species such as willows. Check with local nurseries or landscape designers to discover which species are most suitable for hedges and fedges in your geographical area.



- **Vines** and other climbing plants are often used with garden structures such as pergolas and trellises, as well as walls. Vines and climbers may adhere directly to structures or twist around an available support. Perennial and annual flowering climbers may be jointly planted with shrubs, twining around their branches and capping them with flowers.
- **Perennials** include a large variety of herbaceous (non-woody) plants that die back and reemerge every year. Once established, these plants will advance in size and spread until they reach maturity, after which they can sometimes be divided to obtain new plants. Lower-growing perennials can be used as groundcover (*see also* **Groundcover**). Many perennials range in size from 18 to 30 inches, making them compatible for mixed planting in beds and borders. Caring for perennials is what many people associate with the term "gardening."

- **Meadow species** such as grasses and wildflowers have become important in the cultivated landscape because of interest in native and naturalistic vegetation, as well as growing disillusionment with lawns, which are now considered unsustainable. While full-scale meadows require large spaces, meadow or prairie species such as wildflowers and grasses have made their way into gardens and can be used in setback zones and more open areas as an alternative to turf lawns. For more on meadows, refer to the **Landscape Design Techniques** QuickStudy® guide. Many of these species require full sun and can tolerate poor soil conditions. Here are the primary categories:
  - **Grasses** include a broad range of species, from spreading varieties such as grains, reeds, and bamboo to clumping varieties that are usually termed "ornamental grasses." These are planted individually as perennials in the garden.
  - **Sedges** and **rushes** are grasslike species that are generally more suited to saturated soils and are used in and around ponds.
  - **Wildflowers** include both annuals and broadleaf perennials (called forbs) that are naturally found in meadows and prairie lands. Because of growing interest in these species, seeds and young plants ("plugs") are available commercially for use in cultivated landscapes.
- **Groundcover** is a broad term that refers to a variety of low-growing plants. Often planted under shrubs and trees in beds, groundcovers can be planted alone in non-trafficked areas. Shrub, vine, and perennial groundcovers shade and aerate soil and are preferred alternatives to mulch.
- **Turfgrass** lawns originated as a sign of wealth, and a perfect lawn is still considered a sign of a well-groomed landscape. In the garden, turfgrass lawns provide contrast to the texture and variety of perennial beds. Lawns also provide valuable gathering or play space. The proper choice and blend of turf species are important to the success of a lawn, regardless of whether they are cool season or warm season grasses.

Turfgrass Tip Whether you live in the North or the South, the best seed mix is a combination of grasses that suits your site conditions (soil, sun, and moisture). Characteristics such as growth rate, wearability, and shade and drought tolerance need to be matched with your lifestyle and maintenance habits. You might use anywhere from 20% to 65% Kentucky bluegrass, and that in turn can be composed of three different bluegrass varieties. The same applies to all turfgrasses. Before you seed, contact an extension program available to your community, usually through a state agricultural college, for advice.

- **Cool season grasses** prefer midseason temperatures. This means they are inactive in winter and may turn brown in the summer. The primary components of cool season turfgrass mixes used in temperate zones include:
  - **Kentucky bluegrass:** Highly valued as a tough, resilient turfgrass, although it is slower to establish and is high maintenance. Because it spreads underground forming a thick sod, Kentucky bluegrass can easily reestablish when damaged.
  - **Fescues:** Slow-growing low-maintenance grasses. The fine fescues, such as creeping red fescue (*Festuca rubra*) and sheep fescue (*Festuca ovina*), are among the most shade-tolerant lawn species. While fine fescues can grow in less fertile soils, they are more easily damaged and may require regular overseeding.
  - **Perennial ryegrass:** The fastest-growing lawn species, as it can fill out in 2 weeks in season. Ryegrass recovers slowly from damage and requires full sun and healthy soil to thrive. To improve pest resistance, ryegrass is enhanced with beneficial organisms called endophytes. Because of its rapid growth rate, it can be used to overseed warm season grasses to keep lawns green in winter in southern climates.
- **Warm season grasses** prefer summer temperatures. This means they are less active in the early spring and late fall and will turn brown in the winter. Used primarily in the South and Southwest, these include:
  - **Bermudagrass:** The South's equivalent of Kentucky bluegrass, bermudagrass is a key component in playing fields and other high-traffic areas. This tough, resilient grass can become invasive.
  - **Zoysiagrass:** This is a highly adaptable, slow-growing grass that tolerates diverse soils, some shade, and moderate traffic. Some varieties of zoysia are very soft, fine-textured grasses.
  - **Saint Augustinegrass:** Prefers the moister, warmer coastal fringe of the South and is more shade tolerant than bermudagrass.
  - **Centipedegrass:** A creeping, low-maintenance perennial grass that is more shade tolerant than bermudagrass. Like the fescues, centipedegrass may need overseeding if it gets traffic.
  - **Buffalograss:** This is a hardy prairie grass that develops very deep roots. Once it is established, buffalograss is very drought tolerant.

Native Plants

Since the first days of world exploration, exotic plants have been collected as prestigious garden features. At our current level of globalization, it is getting increasingly difficult to define the term "native."

- **True native species** are those proven to have existed in a country or region before global-scale travel. The sugar maple is considered a true North American native.
- **Naturalized species** are considered near-native, as they have thrived side by side with natives for generations. The ash is an introduced, naturalized species in America dating back to 1724 (white ash) and 1824 (green ash).
- **Exotic plants** are imported intentionally because of their ornamental interest. The way these plants behave within their new ecological community is variable: they may be harmless, or they may carry pests and disease that can affect native plant species.
- **Invasive plants** are opportunistic species that grow and spread quickly, outcompeting native plant species.

Native Plant Tip Know the origin of your plants. Does your local nursery grow their own stock, or are the plants imported from locations with different climatic conditions? You can prevent the spread of disease by buying locally cultivated native species. Do your research, or contact a professional for guidance.

SUSTAINABILITY STRATEGIES

Ecology concerns the creation and flow of energy among the plants and animals in a system (referred to as an ecosystem). When the gardens we create depend on an excessive use of water, fertilizer, pest control, and maintenance, they aren't sustaining themselves. There is much we can do to make our gardens richer and more sustainable.

Strategy 1: Understand Healthy Soil

- **Soil structure** develops over a long time. It contains air spaces and channels that allow for the circulation of oxygen, water, and nutrients. Undisturbed soil has the best structure and should be respected.
- **Organic debris** is decaying plant and animal matter that is decomposed by bacteria and fungi in the soil, providing plant nutrients.
- **Nutrient sources** such as nitrogen and phosphorus are the primary macronutrients, followed by potassium, calcium, sulfur, and magnesium. These may be naturally produced or made available to plants by microorganisms acting on organic and inorganic substances in and on the soil.
- **Soil pH**, or relative acidity, gradually changes with the density and variety of vegetation and wildlife because of accumulating organic matter. As acidity increases, nutrients in the soil become more available to developing plants.

Soil Structure Tips Autumn is the best time to improve the structure of heavy soil by adding texture. Carefully cut the top 6 inches of native soil into large, shovel-size clods, and set them aside. Place a layer of well-rotted manure in the excavated area, and replace the clods (the surface should be rough). Then fill the cracks with more seasoned manure. Freeze-thaw cycles will do the rest of the work for you. In the springtime, don't hoe! Protect the soil with a geotextile fabric to prevent weed growth until the bed is planted. The bed should be higher than the surrounding soil because its improved texture will draw water and it needs to drain.

Strategy 2: Make Your Own Compost

Organic compost makes great mulch. It's the best way to "grow your own soil." Once you get into the habit, you'll be developing your own soil recipe.

- **Essential ingredients of compost** include most organic waste created while preparing food or gardening. Scraps from raw vegetables, coffee grounds, rinsed eggshells and fish bones, leaf litter, and plant clippings are all fair game. Cooked food, aggressive weeds, potato skins, and woody twigs should not be used.
- **Curing compost** takes time, oxygen, and a little moisture. When possible, chop your recycled ingredients to expose more surface area for bacteria to act. To oxygenate the compost, turn it with a pitchfork, layer the compost with straw, or insert hollow tubes into the pile. Other ingredients such as manure can be lightly added to provide nitrogen (which accelerates decomposition). Lime can be dusted over the compost in layers, as this will reduce the acidity enough to favor bacteria. It is unlikely you'll need to add water, unless you are in the driest of conditions.
- **Compost containers** are available, but you can also make your own enclosure. The best containers have access from the bottom so that you can remove the most seasoned compost first. Dark plastic containers help heat up the contents, and this will accelerate curing. Covers can be removed as needed to provide air and water.

Compost Tip It's a good idea to have more than one compost pile. It takes months to cure compost, so you can use one while you are accumulating another.

Strategy 3: Make Smart Plant Selections

Trees, shrubs, and perennials should be chosen according to their solar and moisture requirements. Discover which plants thrive in your area without artificial irrigation. Use a variety of plants with diverse heights and characteristics to create communities. Your goal should be to cover as much soil as possible in the beds. You will need plant books and catalogs to develop your expertise.

Strategy 4: Conserve Water

A successful, sustainable garden should be able to survive on rainfall alone. To reduce your water needs, consider the following:

- **Xeriscaping** is gardening with minimal water requirements. In drier, high altitudes, plants that grow in alpine areas or in scree (crumbled rock) are used. These plants typically have fine leaves and flowers. Grasses are popular in xeriscape gardens.
- **Retaining water** can be done with commercially available rain barrels, artificial ponds, or cisterns buried underground. You can capture rooftop runoff, or you can direct overland flow into a collector. Rainwater doesn't contain chlorine, so it's better for plants. Check local policy and recommendations on the collection and use of rainwater.
- **Greywater recycling** is regulated by state authorities. It entails recycling water from sinks and washers for use in the landscape. This water usually has some soap content, so it should be used with attention to the pH requirements of your plants or simply leached underground with a perforated pipe. Check local policy restricting the delivery and use of greywater.
- **Mulch** has the primary purpose of reducing the rate of water evaporation from the soil. It should be used sparingly in low, damp areas. Mulch should never become saturated, as it will suffocate roots.

Strategy 5: Manage Microclimate

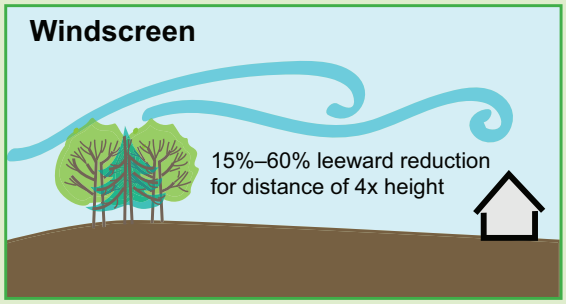
Microclimate is the highly local variant of regional weather trends and is affected by orientation, elevation, and vegetation. Locating trees and shrubs strategically will increase your comfort outdoors and reduce energy consumption.

- Maximizing **solar gain** is the first step in managing microclimate for temperate and cooler climates. Find the space to the southeast of your house,

and keep it clear of trees. This is your sweet spot, and you should use it either as a sunny planting area or for gathering. If it is your front yard, don't waste it all on lawn.

- **Solar heat reduction** can be achieved by planting trees on the northwest of your property, to screen late afternoon summer sun. If you are in a warm climate, you may want some deciduous trees to the south to screen and ventilate. In the winter, these trees will not block the sun.
- **Airflow** can be controlled with trees located in the path of the wind. Depending on density and type of planting, wind speed can be reduced 15%–60% for a distance equal to 4 times tree height. The trees don't need to be close to the house.

Strategy 6: Attract Wildlife



You may think you want to keep wildlife out of your garden, but a viable biological community depends on the presence of birds, insects, and small ground animals to be sustainable. For a rich garden environment, consider the following:

- **Variety:** Plants are like architecture. The more types you offer, the more varied the residents will be. Contact your local horticultural society or state environmental agency to learn about native plant species and their habitat value.
- **Range of heights:** Every garden needs a little bit of up and down. Make sure your garden offers low, spreading plants, as well as tall, spiky species.
- **Mixture:** Avoid segregating plants by type in any bed. Plants are safer from predators in a diverse crowd.
- **Staggered blooms:** Make sure you always have something in flower by studying the probable bloom schedule of your selected plants.
- **Healthy mess:** Don't be too neat. Leaving organic litter around the base of your plants will create cover for small creatures and improve your soil. Don't do this if you have an unmanageable problem with voles or moles.

Strategy 7: Design for Low Maintenance

Many maintenance activities require the use of gas or electrically powered equipment. Irrigation requires the use of drinking water. Fertilizers, pesticides, and herbicides are all pollutants. Use this commonsense checklist to reduce maintenance in your garden:

- Do your plant selections require special care to survive in your geographic area?
- Do your planting beds receive enough sun for the species you've selected?
- Does your design require the regular use of a weed trimmer?
- Have you allowed proper spacing for your plants as they mature?
- Are your trees going to stay clear of your house and power lines as they grow?
- Do you really need all that lawn?

See the **Management** section of this guide for more maintenance help.

MANAGEMENT

Lawns

Lawns can be beautiful, satisfying areas for gathering or play, or they can be boring and time-consuming to maintain. Ideally, lawns should be cultivated in nearly level areas to support active recreation. If you have more than you need, especially in the front setback of your house, think about alternative landscape treatments such as meadows, groundcover, or shrub masses. Here are some things you should think about when creating and caring for lawns:

- **Site-specific seeding:** Don't buy a generic seed mix. Learn the characteristics of each type of turfgrass. Create a seed portfolio that may include several types, and within each type, you may want to test more than one variety. Descriptions of the primary turf species in use today are included in the **Plant Categories & Uses > Turfgrass,** pp. 3–4.
- **Integrated pest management (IPM):** IPM is a holistic, efficient, environmentally sensitive approach to pest management. It combines the following actions:
  - Selecting appropriate species for soil type and site
  - Mixing species for a better defense
  - Knowing your pest tolerance level
  - Learning about the latest low-impact products and when to use them
  - Not overcutting or overwatering

IPM Tip An endophyte is an organism that lives within another. Endophyte enhancement in perennial ryegrass is an example of IPM. In this case, fungi are injected into the ryegrass seed. These organisms ward off attacks by foliar-feeding insects.

- **Root development:** Your lawn will be stronger and more self-sufficient if its roots are well developed. Blade height of grass reflects the depth of its roots, so keep the height of your lawn above 3 inches. This will allow less mowing and greater drought tolerance.
- **The future of lawns:** New varieties of turfgrass are being developed regularly to improve their environmental performance and energy requirements. At the same time, alternatives to lawns such as broadleaf groundcover, meadows, and flower or vegetable gardens may provide more interest and utility.

Irrigation

Plants should be selected for their ability to adapt to the regional climate. Some circumstances may warrant the use of occasional or temporary irrigation, such as new plantings and extreme temperatures. Here are some things to keep in mind regarding irrigation:

- **Root penetration** is essential to a plant's drought tolerance and overall health. Excessive irrigation promotes superficial rather than deep root development.
- **Pop-up sprinklers** are placed in the ground and remain flush to the surface until a timer signals them to pop up and spray the area within their radius. Pop-up sprinklers should be activated late at night or early in the morning to avoid peak water demand and loss through evaporation.

- **Drip irrigation systems** use shallowly buried perforated lines to deliver water directly to plant roots at a slow rate, reducing consumption.
- **Rain sensors** are small rainwater collectors that shut off your scheduled irrigation when it rains and should be a part of every system.
- **Collected rainwater** can be used in your irrigation system and is better than tap water for your plants (*see also* **Strategy 4: Conserve Water**, p. 4).

Weed Control

The idea of "weeds" is cultural. A plant is only a weed if you don't want it growing where it is or you just don't like it. Here are some things to keep in mind if you are inclined to fight unwanted plants:

Herbicide Tip Glyphosate is generally considered to have low toxicity, but glyphosate products may contain surfactants or preservatives that may raise concern about their use. Read the labels and do your homework, as herbicides are constantly evolving. They may be irritating to you and harmful to your garden ecosystem.

- **Chemical suppression:** Herbicides are chemicals that kill plants. They can be selective or nonselective. Selective herbicides are used for turfgrass lawns or agricultural crops to kill weeds. Nonselective herbicides, such as glyphosate (first commercialized as Roundup), are sprayed on individual plants. Herbicides can be preemergent (prevent growth) or postemergent (kill existing plants).
- **Manual removal:** This is the age-old technique that still works very well and gets you outside. Remember that uprooting plants creates an optimal seed bed of loose soil for new weeds. Cutting weeds to the ground is better for the soil. If you don't weed often, make sure you do so before the plants go to seed.
- **Mulching:** Mulch has been used for centuries. Soft, rotting, organic material gradually introduces nutrients into the soil and slows the evaporation of water. Bark or wood chips produced from pruning activities are commonly used as mulch, though they have a high lignin content and decompose very slowly. Organic compost is preferred. Mulch suppresses weeds by blocking sunlight.
- **Geotextiles:** Fabric that blocks light and is permeable to water can be used to cover perennial beds and block weed growth while plants are getting established. Cover prepared soil with anchored fabric and cross-slit the fabric to place young plants. Cover with finely ground compost.

Mulch Tip Use materials that will give to the soil rather than take from it. Nitrogen, an essential plant nutrient, is consumed during the breakdown of coarse bark mulch. Finer, more soil-like compost does a better job of blocking sunlight to prevent weed growth, enriching the soil, and slowing evaporation. Keep it light and loose without disturbing the soil below.

- **Groundcover:** The best way to prevent weed growth is competition by your selected plants. Strive for continuous coverage of bare soil by planting perennial groundcover species. Groundcover will keep soil aerated, provide organic material, and shade the soil to prevent moisture loss and weed growth.

Groundcover Tip Try planting at least three different species of groundcover to guarantee success. Make sure the plants are in the same height range and equally distributed in your beds following the **Perennial Spacing Tip,** p. 3. Look for plants that thrive in your region and can withstand partial shade as your surrounding plants grow and partially block the sun. Combinations such as pachysandra and periwinkle exhibit better texture when used together. Low, spreading, or dwarf shrubs such as cotoneaster, bearberry, and juniper can be used as groundcover under trees. Make sure the plants you select are appropriate to your region.

Pest Control

Like weeds, pests are critters that you don't want around. If you can't coexist, consider the following strategies for pest control:

- **Create a biological community.** The best protection against pests is a rich and varied biological community that will encourage pest predators and establish balance.
- **Alter niches.** A *niche* is a range of optimal conditions that allow an organism to thrive. For example, if you alter the soil's acidity, or pH, you may find that certain pests will be deterred. Adding lime makes soil less hospitable to ants that deliver aphids to roses and other flowering shrubs. Moisture is another factor that can be altered.
- **Remove them physically.** A trip around the garden with a gentle soapy spray or damp cloth can effectively reduce pest populations at the most vulnerable times of the growing season, usually when new shoots or buds are developing.
- **Introduce predators.** A rich garden will tend to have more natural predators, but some can be encouraged. Creating a pond with tall reed plants will invite frogs and dragonflies, both important predators; broad-petaled flowers such as marigolds attract ladybugs, which consume aphids.
- **Avoid chemical warfare.** There are many environmental disadvantages to using pesticides. Try a varied, balanced approach instead.

Pest Tips Garden visitors such as deer, moles, and voles are more challenging. Keep the immediate area around the base of trees and shrubs clear of thick, rough mulch or debris, especially in winter, as this provides cover for gnawing rodents. Limit the use of nitrogen fertilizer, as this promotes tender, vulnerable shoots. Deer are very bold if they are hungry, and they will not be easily deterred. It's wiser to experiment with plants that are deer-resistant and learn to live with it. A deer fence, solid screen enclosures, or double fences (spaced to inhibit jumping) may be somewhat effective, depending on the deer population and the availability of alternative food sources.

Training Plants

Plants that don't have optimal form for the function they are serving—or for your aesthetic goals—can be cultivated to achieve desired results by selective pruning and training.

- **Tying to structures:** Some twining vines will naturally wrap around trellises or other supports. Woody climbing plants with aerial roots may need support until they attach directly to walls or structures. Use soft, fibrous materials to tie plants, and locate the ties under branching points to protect new growth. Be careful not to wound the stems by using wire or tying too tightly.
- **Pruning for form:** An expert should be consulted when pruning trees, but most gardeners can handle shrub pruning. Look at the plant from a distance, and remove branches that conflict with one another or prevent balanced access to sunlight. Use a good pruning saw for larger branches and sharp clippers for smaller branches. A clean cut is the healthiest for the plant. Cut diagonally so that the wound faces downward, away from the rain. When cutting larger branches, be sure to leave at least two buds or shoots below the cut.
- **Clipping hedges:** Shrubs used for hedges need to be clipped for height and evenness. If you want a hedge with a flattop, make sure that you use an appropriate fine-textured species (usually plants with very small leaves). Otherwise, let the plants maintain their natural form and just trim erratic shoots.
- **Training fedges:** Some fast-growing plants such as willows can be tied together and pruned to create a fedge. These are trained to grow in a fence-like pattern by tying rows of young shoots together in a crisscross pattern and restricting their thickness. You can experiment with many creative ways to form a fedge.

Plant Hygiene

Plant Hygiene Tip Whenever possible, plant woody plants in the fall and perennials in late spring.

Part of the fun of gardening is visiting your plants and caring for them throughout the season. Here are some regular activities you will perform:

- **Inspecting:** Just what it sounds like, this involves keeping an eye on your plants to see if they are happy and healthy. If you do this regularly, you will understand when your plants need extra care.
- **Cutting and dividing perennials:** Perennials tend to expand as clumps, and after several years, they need to be lifted and divided. Use a pitchfork to gently pry the clump into several pieces, and replant separately. This is typically done after flowering but not too late in the season. Bulb plants should not be moved until their leaves turn yellow, meaning they have stopped photosynthesizing and have stored food for the next year. All perennials need to be settled in the ground well before winter. You should cut most perennials after they flower and use them for dried arrangements or compost them. Dry grasses look great over the winter and can be cut in spring.
- **Deadheading:** This is the removal of dried flowers from shrubs. Be careful to remove only the flower; plants such as Rhododendron develop the next year's flower buds right underneath.
- **Tree pruning:** This requires great skill, proper equipment, and adequate safety procedures. An arborist can help keep your trees in good shape by removing dead branches and allowing enough light to the plants below. They can also alert you to disease potential and contagion and remove any dead or dangerous trees.

BASIC TOOLS & PRACTICES

Working in a garden is fun and healthy, but it is also work. The key to efficient garden maintenance lies in the following practices:

- **Work in favorable weather**, when the ground is not saturated and the sun is not too hot.
- **Be comfortable**, and don't work when you are tired or angry. You may regret it later. Wear a hat, gloves, and sturdy footwear, and keep your arms and legs covered to avoid scratches or skin irritations.
- **Know your limits**, and decide how long you are going to work before you start, then stick to your plan.
- **Hire landscape professionals** if you don't know how to do something, a job seems too big, or you want to get started with a solid design. Once your garden is established, you can add your personal touch and develop your expertise.

Tool Tip Must-have equipment includes a shovel, a spade, a pitchfork, a rake, a pruning saw, clippers, and a wheelbarrow. When working on your knees in the bed, you'll want a hand spade and a hand rake, as well as a knee pad for comfort. Keep more than one pair of gloves handy, one of which should be fairly waterproof. That's enough to get you started.