

Growing Houseplants

PURPOSE AND EXPECTED OUTCOMES

This chapter discusses the environmental factors required for growing plants indoors and how to choose, grow, care for, and use houseplants.

After studying this chapter, the student should be able to

1. Distinguish between the practices involved in growing plants in the house and under controlled environments (greenhouses).
2. List and discuss the factors that one should consider in growing houseplants.
3. List ten common houseplants.
4. Discuss the correct ways of watering plants.
5. Discuss the correct ways of feeding plants.
6. Describe how plants are repotted.

[COLOR PLATES—see *color plate 8–16* for additional chapter photos]

OVERVIEW

Plants can be successfully grown indoors in a *controlled environment* in which all of the required plant growth factors are supplied in appropriate amounts. Growing plants indoors at home is an activity that enables homeowners to enjoy plants year-round. However, the home environment is not as controlled as a greenhouse environment because the home is shared by humans, and sometimes pets, whose needs take precedence over the needs of plants. Home conditions are generally less than ideal for general plant growth, especially with respect to light. For this reason, not all plants can be successfully grown indoors.

Growing plants indoors necessitates that plants be grown in containers, which restricts the growing environment for plant roots. Choice of proper growth medium is critical to the success of growing potted plants. Also, proper choice of plants is essential in growing indoor plants. After choosing the right plants and the appropriate medium, the grower must employ good management practices to maintain the plants in good health. A green thumb is not hereditary but is an acquired trait obtained through experience and knowledge of basic horticultural principles.

In this chapter, a list of indoor plants is provided, along with the principles of indoor plant culture. The reader will learn how to constitute a good growth medium and is provided with guidelines for caring for houseplants. Further, use of plants indoors either for purely decorative purposes or to serve certain functions is discussed.

11.1 FACTORS THAT INFLUENCE THE CHOICE OF HOUSEPLANTS

The variety in outdoor horticultural plants is tremendous. Similarly, many ornamentals are adapted to indoor environments, although they are fewer in number than field plants. The choice of which plants to grow depends on several factors.

11.1.1 PERSONAL PREFERENCE

Some people are cactus enthusiasts, and others love roses. For some people, it is love at first sight—they decide what to grow when they see a plant growing somewhere. Such people often visit a nursery, ask to be shown some possibilities, and then buy what most appeals to them. People are more likely to invest time and resources in growing and caring for plants that they like, rather than in plants with less appeal. If one decides to be a collector of a certain kind of plants, variety and diversity occur in some species such as *Peperomia* and *Ficus*. *Peperomias* vary in shape, size, texture, and color. In *Ficus*, one can find trees, shrubs, and creeping and trailing plants.

11.1.2 GROWING CONDITIONS

Some houseplants can do well in nearly any part of the room. Others may require special conditions that only an avid flower enthusiast can afford the time and patience to provide. Many people just want a plant that will grow without intensive care (Table 11–1). As will be discussed, houseplants need good care to grow properly.

11.1.3 ROOM DECOR

Plants are used to enhance the room decor. They come in different shapes, sizes, colors, and textures. For best results, when different kinds of plants are used in interior decoration (**interiorscaping** or *plantscaping*), they should not only complement the room furnishings, but also relate well to each other and blend to create a pleasant environment.

11.1.4 PLANT CHARACTERISTICS

Plant characteristics include the following:

1. *General attractiveness.* The plant should be aesthetically pleasing to behold. The foliage and/or flowers should be attractive.
2. *Appearance at maturity.* People seldom purchase fully grown plants for the home. Instead, indoor plants grow and change (e.g., in shape, size, and height). A young plant may not be as appealing as when it is much older.
3. *Growth cycle.* Some plants are only attractive when they flower and may be unattractive in the vegetative state. Some foliage plants are attractive as such and become even more so when they flower.
4. *Growth (maturity) rate.* Houseplants do not grow or attain maturity at the same rate. Although some plants, such as annuals, grow rapidly, others, such as palms, take several years to attain a good size that is aesthetically pleasing.

11.1.5 COST

Houseplants vary in cost. The choice of plants to purchase is influenced by how much the homeowner is willing to pay for the new plant. Some plants (e.g., pothos) are easy to grow and propagate easily, producing vegetative material that can be clipped and shared with other people.

Interiorscaping

The use of ornamental plants for functional and aesthetic purposes.

TABLE 11–1 Common houseplants

<i>Common name</i>	<i>Scientific name</i>
a. Easy to grow	
Cast iron plant	<i>Aspidistra elatior</i>
Christmas cactus	<i>Zygocactus</i> or <i>Schlumbergera</i>
Dragon tree	<i>Dracaena marginata</i>
Lucky bamboo	<i>Dracaena sanderian</i>
Mother-in-law's tongue (snake plant)	<i>Sansevieria</i>
Pothos	<i>Epipremnum</i>
Spider plant	<i>Chlorophytum comosum</i>
b. Somewhat easy to grow	
African violet	<i>Saintpaulia</i>
Aloe	<i>Aloe</i>
Chinese evergreen	<i>Aglaonema commutatum</i>
Croton	<i>Codiaeum variegatum</i>
Dumb cane	<i>Dieffenbachia</i>
Jade plant	<i>Crassula argentea</i>
Parlor plant	<i>Chamaedorea elegans</i>
Peace lily (white flag)	<i>Spathiphyllum</i>
Prayer plant	<i>Maranta</i>
Rubber plant	<i>Ficus elastica</i>
c. Other popular houseplants	
Anthurium	<i>Anthurium</i> sp.
Asparagus fern	<i>Asparagus densiflora</i>
Baby tears	<i>Helxine soleirolii</i>
Begonia	<i>Begonia</i> sp.
Bird's nest fern	<i>Asplenium nidus</i>
Boston fern	<i>Nephrolepis exaltata</i>
Crown of thorns	<i>Euphorbia millii</i>
English ivy	<i>Hedera helix</i>
False aralia	<i>Dizygotheca elegantissima</i>
Fiddle leaf	<i>Ficus lyrata</i>
Gardenia	<i>Gardenia augusta</i>
Grape ivy	<i>Cissus rhombifolia</i>
Hawaiian schefflera	<i>Schefflera arboricola</i>
Heart leaf philodendron	<i>Philodendron scandens</i>
Neanthe bella palm	<i>Chamaedorea elegans</i>
Nephthytis	<i>Syngonium podophyllum</i>
Norfolk island pine	<i>Araucaria heterophylla</i>
Peperomia	<i>Peperomia obtusifolia</i>
Piggyback plant	<i>Tolmiea menziesii</i>
Pittosporum	<i>Pittosporum tobira</i>
Pleomele	<i>Pleomele reflexa</i>
Podocarpus	<i>Podocarpus macrophyllus</i>
Pony tail palm	<i>Beaucarnea recurvata</i>
Purple passion plant	<i>Gynura aurantiaca</i>
Sago palm	<i>Cycas revolute</i>
Staghorn fern	<i>Platycerium bifurcatum</i>
Ti plant	<i>Cordyline terminalis</i>
Umbrella plant	<i>Schefflera</i> (or <i>Brassaia</i>) <i>actinophylla</i>
Wax plant	<i>Hoya carmosa</i>
Weeping fig	<i>Ficus benamina</i>
Zebra plant	<i>Aphelandra squarrosa</i>

11.1.6 SAFETY

Some houseplants contain toxins that can be harmful upon contact to the skin or if ingested. Further, some plants produce flowers and hence some pollen grain that can trigger allergies in humans. If children are going to be in the home, homeowners should not only be concerned about toxic plants, but also about those with anatomic features that can cause physical harm (e.g., pointed tips, thorns).

11.1.7 TOXIC PLANTS

Generally, plants that exude a milky liquid when snapped or bruised (the *Euphorbia* species) contain some toxic substances. Many of the species with underground modified structures (roots, corms, bulbs) contain toxic substances. The toxins vary in potency and most are glycosides or oxalates. While these toxic houseplants may not cause death, they can cause gastrointestinal inflammation and dermatitis. Glycosides like those found in oleander and lily of the valley can stimulate the heart in addition to being irritants to the mouth and intestinal tract. Pothos and saddle leaf contain oxalates that irritate the mouth, lips, tongue, and stomach. Those plants with solanine can cause diarrhea and vomiting.

Houseplants that are relatively more toxic than others, sometimes dubbed the “dirty dozen” are aloe vera, Boston ivy, caladium, dumbcane, English ivy, German ivy, Indian rubber plant, mistletoe, philodendron, potted chrysanthemum, weeping fig, and yew. Other toxic plants are listed in Table 11–2.

TABLE 11–2 Toxic houseplants

<i>Other toxic plants</i>	<i>Comments on toxin</i>	
<i>Amaryllis</i>	<i>Amaryllis</i>	Alkaloid lycorine in bulbs,
Arrowhead plant ; Nephthytis	<i>Syngonium podophyllum</i>	Toxic oxalates
<i>Asparagus fern</i>	<i>Asparagus setaceus</i>	Toxic dermatitis
Azalea	<i>Rhododendrum occidentale</i>	Variable toxins
<i>Bird of paradise</i>	<i>Poinciana gilliesii</i>	Variable toxins
Bittersweet	<i>Solanum dulcamara</i>	Toxic solanine
<i>Boston ivy</i>	<i>Parthenocissus quinquefolia</i>	Toxic oxalates
Caladium	<i>Caladium</i> sp.	Toxic oxalates
<i>Chenille plant</i>	<i>Acalypha hispida</i>	Causes skin and gastrointestinal inflammation
Christmas rose	<i>Helleborus niger</i>	Toxic glycosides
<i>Chrysanthemum</i>	<i>Chrysanthemum</i> sp.	May cause dermatitis
Creeping Charlie; ground ivy	<i>Glechoma hederacea</i>	Variable toxins
<i>Creeping fig</i>	<i>Ficus</i>	Possible dermatitis
Croton	<i>Codiaeum variegatum</i>	Croton oil, strong purgative causes gastroenteritis
<i>Crown of thorns</i>	<i>Euphorbia millii</i>	Variable toxins
Dumbcane	<i>Dieffenbachia seguine</i>	Toxic oxalates
<i>English ivy</i>	<i>Hedera helix</i>	Variable toxins
God toothed aloe	<i>Aloe nobilis</i>	Possible dermatitis
<i>Heartleaf philodendron</i>	<i>Philodendron cordatum</i>	Toxic oxalates
Hydrangea	<i>Hydrangea</i> sp.	Cyanogenetic glycoside
<i>Jerusalem cherry</i>	<i>Solanum pseudocapsicum</i>	Contains solanine
Lily of the valley	<i>Convallaria majalis</i>	Toxic glycosides
<i>Marble queen</i>	<i>Scindapus aureus</i>	Toxic oxalates
Majesty	<i>Philodendron hastatum</i>	Toxic oxalates
<i>Narcissus</i>	<i>Narcissus</i> sp.	Toxic alkaloid lycorin
Needlepoint ivy	<i>Hedera helix</i>	Variable toxins
<i>Oleander</i>	<i>Nerium oleander</i>	Toxic glycosides
<i>Poinsettia</i>	<i>Euphorbia pulcherima</i>	Irritant
Pothos	<i>Scindapus aureus</i>	Toxic oxalates
Rhubarb	<i>Rheum rhaponticum</i>	Toxic oxalates

Saddle leaf	<i>Philodendron selloum</i>	Toxic oxalates
Split leaf philodendron	<i>Monstera deliciosa</i>	Toxic oxalates
Umbrella plant	<i>Cyperus alternifolius</i>	Variable toxins
Weeping fig	<i>Ficus benjamina</i>	Possible dermatitis

11.2 USING PLANTS IN THE HOME

The key to the successful use of plants in the home is creativity and experimentation. Plants are living things and, like people, need regular (in some cases daily) attention. Ornamentals in the home are meant to be enjoyed, so the use of horticultural plants should not be on a scale such that it becomes a chore instead of a joy. Indoor use of plants may involve one, a few, or even a whole room full of plants (*garden room*).

11.2.1 LOCATING PLANTS

Locating plants in the room depends on several factors, described in the following sections.

Architecture of the Room

Some homes have high ceilings and can accommodate tall plants including larger tropical plants such as *Dracaenas*. Some homes are designed with skylights, which can provide the additional lighting needed by some plants. Leaf form and plant shape should complement the architectural style of the room. If the architecture is big and bold, big and bold plants should be selected. Traditional interiors usually require plants with delicate foliage, such as ferns and grape ivy (*Cissus rhombifolia*). Existing features such as fireplaces and mantelpieces should be utilized in the design of plant displays. Plants with distinctive foliage such as the rubber plant (*Ficus elastica*) and Swiss cheese plant (*Monstera deliciosa*) fit in well with the straight lines of contemporary architecture.

Space

Large plants do better in large rooms. Large plants make small rooms appear too crowded. For example, a fully grown weeping fig (*Ficus benjamina*) is out of place in a cottage drawing room. Similarly, a small plant in a large room has virtually no impact.

Level

Plants may be placed on the floor or on pieces of furniture (such as on tabletops or bookshelves). Elevated positions are suited to small plants (Figure 11–1). The top shelves of bookshelves or other high levels are suitable for plants that have trails or long vines. Small plants should be placed on tabletops.



FIGURE 11–1 A potted plant displayed on top of a piece of furniture. (Source: George Acquah)

Color of Walls and Upholstery

Plants should be placed against a background that will bring out their colors. Plants with strong foliage forms are effective against walls with patterns, provided the motifs in the pattern and leaf size contrast sufficiently. The leaves of the umbrella plant (*Schefflera phylla*) are effective against a background of small-patterned wallpaper. Where the background consists of bold, abstract designs, it can be balanced with a display of plants with delicate foliage such as asparagus fern.

11.2.2 SPECIFIC USES OF INDOOR PLANTS

Plants may be used to perform certain functional roles in the room.

Fill in Gaps

Plants are often placed in areas too awkward for a piece of furniture, such as a corner.

Brighten Up an Area

Flowering plants in bloom can brighten up the room. A variety of dull spots occur in a room (e.g., empty walls, unused fireplace, stairwell, and corners). Plants with distinct leaves, such as the silhouette plant (*Dracaena marginata*), climbers (e.g., trained on poles), or other trailing and cascading plants mounted on wall brackets may be displayed against an empty wall. Because some dull spots such as corners usually have poor conditions for plant growth, plants adapted to such conditions (e.g., *Aspidistra*, *Sansevieria*, and *Philodendrons*) should be chosen.

Cover Up Sharp Edges

Potted plants can be positioned to cover the edges of walls or architectural features. For example, climbers such as *Fatshedera lizei* can be used in the stairwell.

Create Room Dividers

Instead of using wooden structures, for example, appropriate plants may be arranged to form a wall (Figure 11–2). Where dividers are used, plants such as *Philodendron* or *Hedera* may be trained to grow over these physical structures. Trailing or climbing plants need to be monitored and pruned or trained to keep them within desired boundaries. Plants may be positioned to climb up structures or cascade down them. Sometimes smaller displays such as a *terrarium*, bottle garden, or a small group of plants may serve the purpose of separating one area of the room from another.

FIGURE 11–2 Room dividers created with living plants.
(Source: George Acquaah)



Window Displays

Plants in windows enhance the room decor. Since light enters the house primarily through windows, the selection of plants to use should consider the position of the windows, the plant sensitivity to light, and the plant size. While south-facing windows receive sunlight year-round, north-facing windows receive the least amount of light, especially during the winter. North-facing windows favor foliage plants such as aspidistra and sansevieria. Desert cacti do well in unshaded south-facing windows.

Fragrance

Certain plants exude sweet scents that freshen the indoor atmosphere. For example, scented pelargonium has a pleasant fragrance.

Direct Traffic

Plants can be strategically arranged to steer people away from certain parts of the room and to prevent people from using certain spaces as pathways.

Cover Up Undesirable View

A window garden may be planted to block the view to unattractive areas on the outside. Plants may be arranged to hide unsightly parts of a room.

Environmental Quality (Air Quality Control)

Certain plants are known to improve the air quality of indoor areas by absorbing contaminants in the air (Table 11–3). Contaminants include fumes from cleaning solvents, radon, secondhand smoke, furniture, carpeting, and ozone from copying machines. Some of the most effective plants for this purpose are gerbera daisy, chrysanthemum, golden pothos, and *Spathiphyllum*.

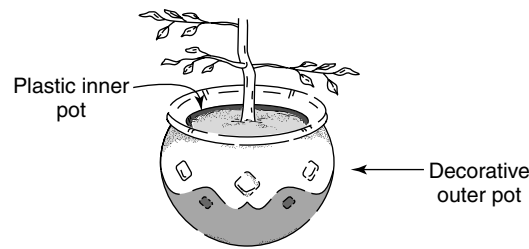
11.2.3 IMPROVING THE DISPLAY OF HOUSEPLANTS

Apart from selecting appropriate plants and arranging them effectively in the room, there are several specific ways in which the display can be enhanced:

- 1. Use a spotlight to draw attention to conversation pieces or specimen plants (unique plants that invite conversation). Backlighting enhances the display of some species such as Boston fern (*Nephrolepis*). Certain plants may be displayed in less-than-ideal conditions with appropriate lighting.

TABLE 11–3 Houseplants that clean the air		
Pollutant	Sources	Plants
Benzene	Detergents, gasoline, oils, tobacco smoke, printing inks, synthetic fibers	English ivy, dracaena, chrysanthemum gerbera daisy
Formaldehyde	Carpeting, clothing, furniture, foam insulation, household cleaners, paper goods, particle board	Azalea, palms, chrysanthemum, diffenbachia, golden pothos, mother-in-laws tongue, poinsettia, spider plant
Trichloroethylene	Adhesives, dry-cleaning fluids, lacquers, paints, varnishes	Chrysanthemums, gerbera daisy, dracaena

FIGURE 11-3 (a) Displaying a plant potted in a plastic pot in a more attractive decorated pot. (b) Examples of decorative containers. (Source: For (b) George Acquah)



(a)



(b)

Double Potting

A method of enhancing the display of potted plants by placing the potted plant in a more decorative pot.

2. Use decorative containers to hold the plants (**double potting**). The plastic pot from the nursery may be placed in a very attractive container to enhance the display (Figure 11-3). Other containers include wicker baskets, brass saucepans, and in some cases patterned containers. When using patterned pots, the color of the foliage and flowers should blend well with the pot color and pattern. Growers do not often plant directly into decorative containers. Instead, they are used as outer coverings to hide the ordinary flowerpot. Containers may be clay or china.
3. Group plants. Instead of scattering plants throughout a room, a number of plants of the same type can be grouped together (massed). Compact plants may be grouped on a stand, on a pebble tray, or on a table as a centerpiece. Small specimens may also be effectively displayed in tiny, unusual containers (e.g., egg cup). Colorful seasonal plants such as tulip, hyacinth, azalea, and geranium can be massed on a windowsill.
4. Use hanging baskets. By themselves, hanging baskets can have very attractive holders. Plants grown in hanging baskets offer some of the most attractive displays.
5. Use ornamental paper. Wallpaper and plants can be used together to provide an effective display, with the paper as the background.
6. Use plant support. Plants may be displayed on pedestals, wooden tables, glass-topped, wrought-iron tables, and other such specially designed supports (wooden or metal jardinières, tiered plant stands, and aspidistra stands). Other pieces of furniture in the house can be adapted as flower stands (e.g., corner cupboards and washstands). Plants may be grown and displayed on a plant trolley.

11.2.4 GROUPING PLANTS

A large plant can be effectively displayed alone. Smaller specimens do better when grouped. Grouping can be accomplished by arranging individual potted plants together (e.g., on a gravel tray) or by planting a mixture of plants in large troughs (Figure 11-4). A wide variety of containers are available for use. They vary in type of material (e.g., plastic, wrought iron, wood, and clay), shape, size, and decorative appearance.

CONTAINER GARDENS

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Container gardens are a condensed and mobile form of gardening. Many plants are packed into a small space for an instant effect that can be easily changed each season. Container gardens offer gardeners an opportunity to be bold, dramatic and to experiment with plants in a non-committal way. Container gardens can now be purchased ready-made also called do-it-for-me (DIFM) for instant color on the patio. If preferred, an assortment of plants can be purchased for do-it-yourself (DIY) container gardens.

One should always select top quality plants, but otherwise, just about any type of plant can be used in container gardens. Possible exceptions would be extremely slow-growing plants, plants lacking attractive foliage that only flower for about two weeks out of the year, very large plants, or plants with deep tap roots. Plants commonly used in container gardens today are seed or vegetatively propagated annuals, herbaceous perennials, herbs, vegetables, grasses, bulbs, tropical foliage plants, succulents, and woody shrubs.

How many plants to put in a container garden depends on the size of the container. The rule of thumb is to use bigger and/or more plants with larger containers and to use less and/or smaller plants with smaller containers. It is best to use odd numbers of each type (i.e., species or cultivar) of plant to achieve a natural and rounded look. One to three plants of each type should be adequate to make a visual impact in the container garden.

A fun and inexpensive way to learn plants and their cultivars that are adapted to a specific location is to visit close-by public or university trial gardens. One should purchase and grow a few new cultivars/species each year to experiment and learn their appeal and adaptability. The more one knows about plant materials that are available and adaptable in a specific climate the more unique the container gardens will be.

The container for a container garden can be just as important as the plants. Make sure the container has a drainage hole. If a perspective container does not have a drainage hole initially, one can be drilled with a masonry bit. It may be necessary to elevate the container slightly off the ground so that water can move freely from the drainage hole. Attractive “feet” or stands can be purchased for this purpose. Do not add coarse gravel to the bottom of the container as it causes a perched water table rather than improving drainage. A few pieces of shale or broken pieces of pots can be

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FIGURE 1 In this container garden, foliage color, form and texture are the dominating elements of design. The bold, fuzzy textured *Salvia argentea* grabs attention to develop focus in the center of the composition. Lotus ‘Amazon Sunset’ adds color echo for rhythm and a fine texture for contrast to the coarse, gray foliage of the salvia. Coleus ‘Compact Red’, coleus ‘Stormy Weather’ and ipomoea ‘Blackie’ (clockwise) complete the container garden. Designed by Lori Osburn Photographed by Lori Osburn



FIGURE 1
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The container can be any shape or size; however fourteen inch and larger containers hold more media. The increase in soil volume in a large container is beneficial for reducing frequency of watering. A large container holds more plants having the potential to be more colorful and textural, thus pleasing to the eye. Hanging baskets and rectangular troughs are vessels that will hold mixed plantings to hang from arbors, light poles, and window sills.

Container gardens can be filled with plants from early spring using cool season annuals and spring blooming perennials and bulbs, for example. In the summer, they can house heat-tolerant annuals, tropical foliage plants, summer blooming perennials, herbs, succulents, etc. Fall and southern winter container gardens can be made using frost tolerant

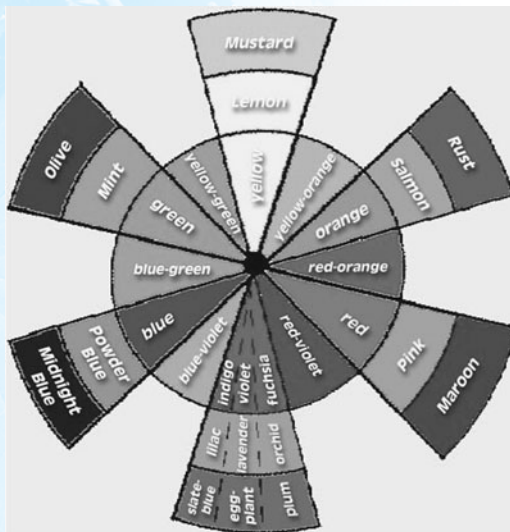


FIGURE 2 This Flower Color Wheel is similar to an artist's color wheel but uses names that florists commonly use to describe color. This color wheel divides the primary color of violet into three additional segments to include indigo (bluish violet) and fuchsia (reddish violet) because there are so many variations of violet in flower colors. Designed by Terri Starman Photographed by Kristen Eixmann

(This item omitted from WebBook edition)

FIGURE 3 The maroon (a shade of red) coleus 'Compact Red' adds depth and draws the eye deep into the otherwise pink (a tint of red) monochromatic (one color) container garden. Different flower forms (daisy, cluster, and star-shaped) and foliage forms (upright, bushy, and trailing) are design elements that make this container garden interesting. Agastache and dracaena back each other with their vertical forms to establish the height of the container garden. Argyranthemum 'Comet Pink' serves as a filler plant; verberna 'Babylon Pink' takes the corner position and bacopa 'Penny Candy Pink' fills the edge position.

Designed by Terri Starman Photographed by Lori Osburn

annuals and hardy perennial species. Fall and winter container gardens can be brought inside under incandescent or fluorescent lights or left outside and covered with cloth in inclement weather. Further north, attractive, tasteful, non-living plant materials can be used in outdoor containers for decoration in winter.

Container gardens are small gardens that will need to be cared for throughout the season. Container gardens are dynamic and constantly changing. Individual flowers will bloom and die and plants will intertwine and grow together. Some plants may go dormant or die out and can be replaced with other interesting plants. Dead-heading flowers and pruning back aggressive plants is healthy for the plants and it can be enjoyable to touch and smell container gardens while tending to them.

The species of plants put in the same container should be compatible as to temperature, light and water preferences. Use plants that tolerate low light for shady locations. Since microclimates can exist within containers, some shade-loving plants can actually thrive underneath sun-loving plants that grow up and provide shade to them. In addition, patio light levels vary throughout the day, so the container may be in direct sunlight for part of the day and in shade the other part. Also, because container gardens are mobile, they can be moved around the patio to provide the optimum sun and wind exposure throughout the different seasons.

It's best not to mix drought-tolerant species with those that need lots of water. Container gardens will dry out more quickly and need to be watered more often than plants in the ground. It is not unusual to water them everyday in the heat of summer. Mixing sterilized field soil into the soil-less potting media when planting will help the



FIGURE 4 This container garden uses several bulbous species with annuals. The mixture of flower forms, sizes, statures and textures are what make the container garden stimulating. Gladiolus 'Muriel' (star-shaped), lily 'Salmon Classic' (cupped), calla 'Captain Romance' (unusual), streptocarpella 'Conord Blue' (nodding), begonia 'Fimbriata Yellow' (solid), and begonia 'Sinbad' (variegated foliage) (clockwise) fill this 11" tall X 14" wide container. Designed by Lauren Edwards Photographed by Kristen Eixmann



FIGURE 5 This container garden emphasizes foliage forms and textures and uses an all neutral color scheme (black, white, and gray). Calla 'Schwazwalder', Gypsophila paniculata 'Festive Star', Trifolium repens 'Dark Dancer', Eranthemum nigrum 'Ebony', Japanese painted fern, Calochortus 'Cupido' and Carex flagellifera 'Toffee Twist', (clockwise) enhance each other in a 10" tall X 15" wide container garden. Designed by Terri Starman Photographed by Kristen Eixmann

media hold water and make it available to the plants. Because of its physical structure, rockwool will also improve water holding capacity when added to a soil-less media. Saucers placed under the containers are also good for reducing watering frequency. On the other hand, amendments such as coarse bark or perlite can be added to improve drainage.

Homeowners will need to fertilize their container gardens. One teaspoon of a water soluble 20–20–20 dissolved in one gallon of water applied every two weeks will supply about 300 ppm N which is enough to keep the plants healthy. Or, an encapsulated, slow release fertilizer can be sprinkled on the potting media surface. Slow release fertilizers are sold at garden centers and one can follow the directions on the package. The fertility is released from this type of fertilizer when the potting media is watered. When watering with plain water or when applying soluble fertilizer, hold the watering can spout or hose nozzle at the rim of the container and add water until some water leaks from the drainage hole in the bottom. This should take a few minutes, so make certain that the water is being soaked up by the entire root area and not just dripping down the inside wall of the container and out. One way to check for this is to lift or tilt the container enough to feel if it is getting heavier as it is being watered.

It is best to grow or purchase plant material for a container garden that is already starting to flower or otherwise maturing in 4 to 6-inch size pots and then plant them together in the final large container. Keep the plants in their pots and arrange them on top

FIGURE 6 The focal point lies deep in the center of this container garden and is established by the radiating leaves and emerging flower of eucomis 'Bicolor'. Its unusual plant form and hefty leaves also help to grab attention. A microclimate is formed underneath the canopy of eucomis and coleus 'Sedona' to filter light for the shade-loving plants below which include tatting fern, huechera 'Amber Waves', ajuga 'Black Scallop', hosta 'Fragrant Bouquet', impatiens 'Infinity Salmon' and streptocarpella 'Conord Blue' (clockwise). The terra cotta color of the 14" tall X 11.5" wide decorative container contributes to the blue and orange complementary color harmony. Designed by Terri Starman
Photographed by Kristen Eixmann



FIGURE 7 *Curcuma petiolata* 'Emperor' (Siam Tulip) forms the center, while Breynia, Japanese forest grass 'Aurora', and Japanese painted fern serve as fillers. Caladium 'Florida Sweetheart' is the focal plant in the corner position and *Lysimachia nummularia* is in two edge positions. The various plant species are compatible for a shady location on the patio. Designed by Phil Campbell
Photographed by Terri Starman



of the large container filled with potting media before actually planting them. This will allow for easy, quick modifications in the planting design. When all plants are in the desired positions, remove them from their individual pots and plant them in the potting media, working from the center to the outside edge.

Variety in moderation is the key when choosing flowers for container gardens. Include plants with different flower forms to add interest and avoid monotony in container gardens. For example, use one plant in a container garden that has a daisy-type flower form like *osteospermum*, one with tubular flowers like *nicotiana*, and one with cluster flowers like *heliotrope*. Look for a variety of flower sizes too because it is good to have a large flower that adds a focal point or thrill factor, mid-size flowers to add mass and small flowers to transition or fill in between other flowers and foliage.


Achieve balance and proportion with plant size and plant positioning in the container. Within the container, the plants will fit into one of four positions. The center position should be filled a plant that is sturdy and upright in growth habit like *phormium* for example, to add height to the container garden. In order to create massive height and fullness in a very large container, and when aiming for a full-bodied look, plant three plants of upright stature together in the center of the pot. Around or next to the center of the container garden should be filled with filler plants which typically have upright but compact, yet bushy growth to add stability around the center plant(s) and round out the top of the container. *Coleus* makes a very good filler plant, as one example.

Next to the filler plant goes corner plants that grow up, out and then down over the edge of the container. Corner plants, like *petunias*, add bulk at the bottom of the container so the media is covered and the center and filler plants' stems are not overly exposed. The fourth position to fill in the container is the edge. Edge plants that drape over the rim of the container will soften it and fill in spaces between corner plants. Edge plants are horizontal-growing, trailing, or creeping plants like *English ivy*. Not only the habit of the plant, but the size of the container, will determine where a plant works best within that container. For example, a plant may be a center plant in a smaller container and a filler plant in a larger container.

When planting container gardens, some plants are selected for the appeal of their foliage rather than their flowers. Species having at least three textures of foliage (fine, medium, and coarse) mixed in a container garden will make it more appealing. Foliage with large leaves will provide a bold background to stage the flowers of a plant that has good flower power but fine foliage of its own. This principle keeps a container garden from looking messy and weedy. If a good flowering plant also has bold foliage, another plant with fine foliage placed next to it in the container garden will add textural contrast. When selecting foliage for container gardens, look for interesting colors such as gray



FIGURE 8 The analogous color harmony and various plant forms are what make this container garden attractive. The terra cotta container repeats the color of the salmon *artotis* 'Flame' daisy flowers and *ipomoea* 'Sweet Caroline Bronze' leaves. The red-orange *fuchsia* 'Koralle' flowers add accent and their nodding flower form help give the container garden rhythm. Maroon leaves of purple fountain grass and *Alternanthera dentata* complete the analogous color harmony. The gray foliage of *artotis* 'Flame' helps to brighten the container garden. Designed by Terri Starman Photographed by Terri Starman



(*helichrysum*), silver (*dichondra*), maroon (*coleus*), black (*huechera*), brown (*carex*), and chartreuse (*ipomoea*). Plants with spots (*hypoestes*) and stripes (*canna*) or other patterns on the foliage will add surprise and uniqueness to a container garden.

A color wheel can be used as a tool to develop a color harmony for a container garden. The most subtle color harmony to use is one color (monochromatic) with all flowers and foliage being tints and shade of that one color or neutral shades of white, black or gray. An example would be using all plants with some flowers that are violet, some that are a tint of violet (*lavender*) and some that are a shade (*eggplant*) of violet.

One may choose colors next to each other on the color wheel to make an analogous color harmony. An analogous color harmony is still subtle but more invigorating than monochromatic. An example would be using plants with flower colors in the red, red-violet, violet, and blue-violet area of the color wheel. Or, one may choose colors across from each other on the color wheel, called complementary, to get more contrast and a more exciting color harmony. An example would be using yellow and violet flowered plants. Colored containers can be used to provide hues that are hard to find in flowers and foliage and will become an integral part of the overall container garden color harmony.

A grower can start sowing seeds and/or receiving seedling plugs and rooted liners in January for a spring container garden crop and continue receiving plugs and liners through March. Plants should not arrive at or be started in the greenhouse too early or they will become overgrown. Timing and scheduling are critical. The goal is to try to get all the plants to be compact and full and keep them in proportion to each other for planting in the final container. Vegetative annuals, for example, will take only six to eight weeks to flower and be ready to transplant to the final large container. Early arrivals would be perennials and other plants that take longer to grow than annuals.

The rooted seedlings and plugs should be transplanted upon arrival into 4 or 6-inch pots using a general purpose soil-less substrate. Plants will need to be watered in after transplanting. During production in the greenhouse, fertilizer can be applied with every watering using 15-5-15 or 20-10-20 at 200 to 300 ppm N. Check electrical conductivity and pH of the media periodically and adjust fertility level as needed. Use insecticides and fungicides when necessary to maintain plant health and quality.

Pinch any plants that tend to grow as a single stem to make them branch. Prune plants back and round their growth when they start getting too large. However, limit pruning because it is labor intensive thus expensive and plants will start to get distorted. The height of some really fast or large plants can be controlled with plant growth regulators. Plant growth regulators should be used sparingly and not on all plants because plants for container gardens need to grow naturally and hold their flowers up high above the leaf canopy. Keeping the various cultivars and species of plants in proportion to each other on the bench will give a consistent, uniform group of plants when it comes time to put the container gardens together.

By mid March and through mid May start planting the container gardens for Easter through Mother's Day sales. Utility type nursery liners of 14, 17 or 23-inch diameter can be used and slipped down into decorative containers later or at the retail outlet. The containers can be filled half-way full with media the day before, so planting is mostly placing the plants in the proper order into the final container and filling in around them with a small amount of additional media. When doing a mass planting of several container gardens of the same type all at once, it would be wise to make a prototype first, to determine if the planting design needs adjustment before starting a planting assembly line. Design container gardens by placing the chosen plants together on top of the pot before any actual planting is done. Changes can be made by mixing and matching plants. Then begin to plant from the center to the outside edge.

When planting the container garden, space plants closely so the root balls of individual plants are touching for instant beauty. Plants of different growth habits may be placed closer together than those of the same habit. This way all of the container gardens will look salable as soon as they are planted. Most of the container gardens get more attractive as they become established in the container and begin peaking in bloom and

perfection about four to six weeks after planting. When leaving the greenhouse in spring, container gardens may need to be acclimated. Acclimatize container gardens by putting them outside under shade cloth for a couple of weeks to get them used to the higher light intensity and cooler temperatures outdoors.

A retailer can set up Container Garden Boutique within the garden center. Do-it-for-me (DIFM) i.e. ready-made container gardens can be arranged in their own kiosks within the boutique. These ready-made container gardens should have price tags for sale but also serve as mannequins for those customers who would rather buy the plants for Do-it-yourself (DIY) container gardens. In close proximity, customers should be able to find everything they need for building and maintaining their container gardens. The boutique area should have plants, containers, media, slow-release fertilizer, tools and accessories for containers gardens and for decorating patios. A potting bench for customers could be provided for those who don't have the room or desire to do potting at home. Employees should be on hand for consulting with consumers. It is a good idea to group plants by color for use in container gardens. This helps customers to choose the colors they need and it makes an attention-grabbing display. Plants can also be sub-grouped by their light needs.

Container gardens are heavy and delivery is a service that will set an independent garden center apart from the mass merchants and will help sell container gardens. Container gardens can also be rented for special occasions. Customers are happy to pay the price necessary to make their homes beautiful and to amaze their friends. Maintenance of container gardens must be done, so it's up to the industry to either educate consumers on how to do it or offer it as a service. Well-groomed container gardens are going to need weekly inspection and be cleaned and dead-headed to remove any dead foliage or spent flowers. Summer container gardens may need to be replanted once over the summer in warmer climates. It is a good idea to offer "replacement packs" for purchase to replant container gardens. The pack should have a handle for carrying home easily. A service for seasonal replanting could also be offered.

Container gardens should not be priced solely on indirect plus direct costs as other floriculture products. Some compensation should be recouped on the training and expertise of employees for designing and building pleasing, high quality container gardens. It is wise to have three or four price points ranging from \$29.99 to \$200. These might be \$49.99, 79.99 and \$149.99 depending on the cost of the container and the market. If the container gardens are beautiful, the plants are high quality, the designs are awesome, and the consumer wants them, they will sell. It is important to track sales to determine the profitability of a Container Garden Boutique or program. If they are not selling at these price points, then adjustments will need to be made. But growers and retailers should not sell themselves short and should make a good profit on this specialty, high value and desirable product.

Books

Tips on Designing, Growing and Marketing Mixed Baskets and Containers, Peter S. Konjoian, Terri W. Starman and Kathy Pufahl, published by OFA Services Inc., Columbus, OH.

Vegetative Annuals: Guide to Crops and Container Gardens, Terri W. Starman, published by Meister Media Worldwide, Willoughby, OH.

Container Garden Websites on Aggie-Horticulture at Texas A&M University
“<http://aggie-horticulture.tamu.edu/floriculture/container-garden/index.html>”
“<http://aggie-horticulture.tamu.edu/floriculture/containertrials/index.html>”



FIGURE 11-4 Planting different species of plants in one container. (Source: George Acquah)



FIGURE 11-5 When different species or types of plants are grown in a single container they may be selected and arranged to create an overall shape. (Source: George Acquah)

After choosing a container, the next task is to choose the right combination of plants. Plants should be grouped according to their need (e.g., sun loving, partial light loving, and moisture loving). Certain plants such as sansevieria are adapted to less-than-ideal conditions and hence can be utilized in a variety of groups. The combination of plants should also consider the plant size, color, form, and texture. Plants can be grouped to create an overall shape (Figure 11-5). Further, one may include a flowering plant in an arrangement to give it some color. It may be necessary to prune periodically to maintain a good balance in the display. Plants should be repotted, or replanted, when the container becomes too small for them. During replanting, the original set of plants may be retained or new ones included.

11.2.5 GROWING PLANTS IN THE WINDOW

Displaying plants in windows is very popular because windows (especially south-facing windows) are the source of most of the natural light entering the house. Although plants in south-facing windows are prone to scorching due to excessive light, those in north-facing windows may not receive enough light. Windows experience temperature fluctuation, some of which is due to either cold or warm drafts from air conditioners or radiators located beneath windows. Nonetheless, with good care, one can raise healthy, attractive plants on a windowsill or near a window. They can range from single-potted plants to an elaborate plant display (Figure 11-6). They can be displayed inside or outside the window (Figure 11-7). Plants in the window display do not have to be displayed on the sill and can instead be hung in hanging baskets. Shelves may also be constructed in windows so that tiers of potted plants may be arranged. A window may be modified to create a container (such as a terrarium) in which plants can be grown. After arranging the pots, the base of the container may be filled with moss to hide the pots. Lighting may be installed, as well as automatic mist spraying and temperature control units. Plants for display in well-lit windows are presented in Table 11-4.



FIGURE 11–6 Flowers displayed on the windowsill. (Source: Peter Anderson © Dorling Kindersley)



FIGURE 11–7 A window garden—Flowers growing in a container outside the window. (Source: © Dorling Kindersley)

TABLE 11–4 Plants That Grow Well under Well-Lit (Window or Full-Sun) Conditions	
Plant	Scientific Name
Bougainvillea	<i>Bougainvillea spectabilis</i>
Medicine plant	<i>Aloe vera</i>
Amaryllis	<i>Hippeastrum</i> spp.
Bird-of-paradise	<i>Strelitzia reginae</i>
Lipstick vine	<i>Aeschynanthus lobbianus</i>
Rubber plant	<i>Ficus elastica</i>
Coleus	<i>Coleus blumei</i>
Hen and chickens	<i>Escheveria peacockii</i>
Fuchsia	<i>Fuchsia</i> × <i>hybrida</i>
Gardenia	<i>Gardenia jasminoides</i>

11.2.6 GARDEN ROOMS

Garden rooms are usually extensions of the main part of the house designed to be sunny. A large variety and number of plants are housed in the room, but some space is reserved for large furniture. Ideally, the garden room is adjacent to the living room. The structure may consist of panes of glass or some other durable and transparent material. Designs vary widely, with some homeowners installing pools in their garden rooms. The floor of the room may be made of wood, ceramic tile, or some other kind of material.

Plants may be grown in pots or ground beds or hung in baskets. A large variety of plants are grown successfully by strategically placing plants in the locations where they receive the best available conditions. For example, sunlight-loving (or light-loving) plants should be located near windows. It should be remembered that a garden room is meant to provide a comfortable environment for people before plants. As such, plants that prefer high humidity should be avoided, since such an environment will make it uncomfortable for humans to use the garden room. Plant species suitable for greenhouse production, including *Acacias*, *Musa enseta* (dwarf banana), *Eucalyptus*, dwarf conifers, potted roses, garden annuals, cacti, and some *bonsai* can be raised in a garden room.

Garden Room
Usually a casually furnished extension of the living room that is sunny, has room for lounging, and houses a large collection of plants.

11.2.7 HANGING BASKETS

Hanging Baskets

A potted plant grown and displayed, usually by freely suspending it or attaching it to a wall.

Hanging baskets provide another avenue for displaying houseplants (Figure 11–8). An advantage of using hanging baskets is that it allows plants to be displayed in very awkward places such as over doorways and suspended from ceilings, patios, and walls. In this way, plants can be grown at eye level. Hanging basket containers can be made of wood, wire, ceramic, or plastic. For wall attachments, the container is halved (i.e., flat on one side) so that it can be fixed to the wall. Suspended baskets are usually round. The container may also be solid sided or made of wire. In the latter case, a lining of plastic (less attractive) or moss is needed before the planting medium is placed. The advantage of wire baskets is that plants can be planted on both the inside and outside of the container to cover it up completely (Figure 11–9).

FIGURE 11–8 Plants with vines and other hanging structures can be effectively displayed in hanging baskets. (Source: George Acquah)



FIGURE 11–9 (a) Creating a hanging basket. (b) A completely planted hanging basket. (Source: For (a) Peter Anderson © Dorling Kindersley, (b) © Dorling Kindersley)



TABLE 11–5 Selected Plants for Hanging Baskets

<i>Plant</i>	<i>Scientific Name</i>
Begonia	<i>Begonia</i> spp.
Spider plant	<i>Chlorophytum</i> spp.
Aparagus fern	<i>Asparagus</i> spp.
English ivy	<i>Hedera helix</i>
Boston fern	<i>Nephrolepis exaltata</i>
Coleus	<i>Coleus blumei</i>
Wandering Jew	<i>Zebrina pendula</i>
Lipstick vine	<i>Aeschynanthus</i> spp.
Swedish ivy	<i>Plectranthus australis</i>
Pothos	<i>Scindapus aureus</i> (or <i>Epipremnum aureum</i>)
Heart leaf philodendron	<i>Philodendron scandens</i>
Christmas cactus	<i>Zygocactus truncatus</i> ; <i>Schulmbegergia hybrids</i>

Like potted plants, it is critical that hanging basket containers drain properly. However, hanging baskets dry out much more quickly than potted plants on the floor or tabletop because they are exposed to warmer temperatures (since warm air rises) at the level at which they are suspended (about 3°C or 5°F warmer) and airflow around them is much greater. Hanging baskets should be watered more frequently than regular potted plants. Wire basket designs dry out more quickly than solid-sided container designs. To add to the decor, some homeowners replace the wires attached to the pots for suspension with decorative chains or fabric support. Hanging baskets need attention similar to that for potted plants. Some species prefer sunny conditions, whereas others prefer shade (Table 11–5). Plants should be fertilized as needed.

11.3 CARING FOR HOUSEPLANTS

Houseplants need all of the growth factors that are obtained in the outside environment—good *soil*, *air*, *water*, *light*, and *nutrients*. Houseplants, however, differ in the quality and quantity of each factor required for optimal growth.

Caring for houseplants starts with bringing home healthy plants. Commercial nurseries grow plants under controlled conditions year-round. These conditions are adjusted to suit the needs of plants. However, at home, even though homeowners adjust the house temperature as the seasons change, these adjustments are designed for the comfort of people, not plants. Rooms are often evenly heated or cooled. It is very easy for the homeowner who is not a houseplant enthusiast to forget about the special needs of plants in the home.

11.3.1 BRINGING PLANTS HOME SAFELY

In spring or summer, temperatures in nurseries and homes are not likely to be significantly different. More significant differences are likely to occur between the home and the nursery during the cold period (early fall to early spring). Buying plants for use in the home requires the most attention and care during this period to reduce shock to plants. Plants purchased in the cold season should be transported with some insulation. The car should be heated before plants are moved into it from the nursery. For long-distance transportation, plants may be placed in cardboard boxes and wrapped in several layers of paper. Some plants are more delicate than others.

11.3.2 MONITORING LIGHT

A photographic light meter is used to determine light intensity. Light is a critical requirement for plant growth and development. The average light intensity in a house is about 55 **lux**, compared with more than 130,000 lux outside on a bright sunny day. A room is

Lux

The metric unit expressing the illumination falling on all points on a surface measuring one meter square, each point being one meter away from a standard light source of one candle; 1 lux = 0.093 foot-candles.

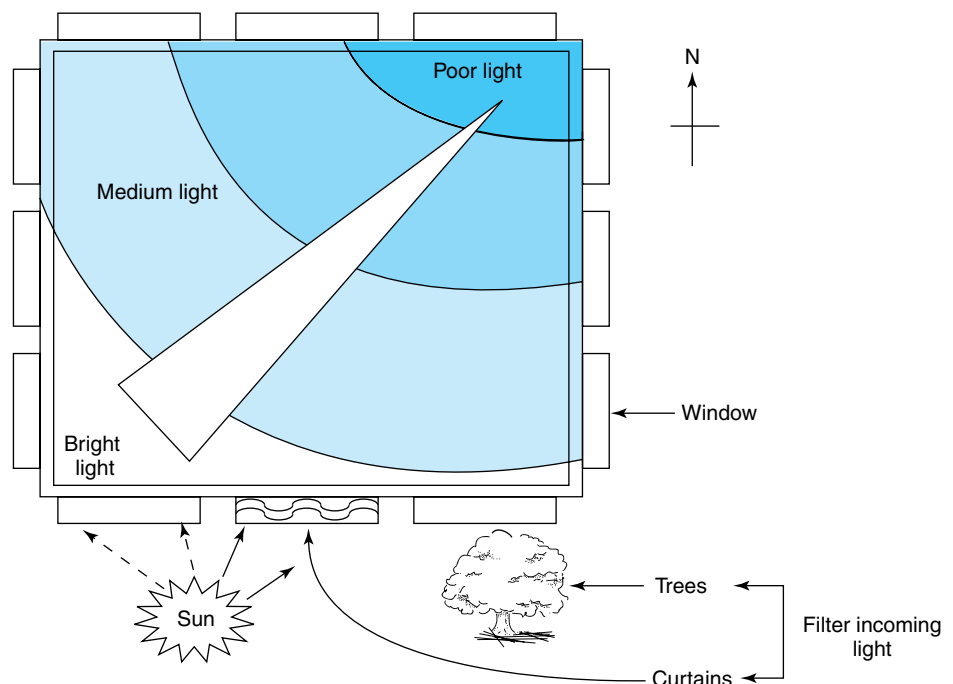
not uniformly lit. While plants are in the care of commercial nurseries, light conditions are maintained at optimal or near-optimal conditions, which usually means at higher intensities than would be found at home. For example, tropical foliage plants generally prefer high light intensities (above 10,000 lux and in some cases even above 30,000 lux).

Chloroplasts in leaves are known to orient themselves differently to suit high- and low-intensity light conditions. The problem with houseplants arises when they are transferred from the greenhouse (high intensity) to the home (low intensity). This change is drastic for many plants, which immediately begin to readjust to adapt to the home environment. Plants readjust differently, with variable consequences in terms of their aesthetic value. Some plant species such as *Ficus benjamina* and *Coleus hybridus* adjust to low light levels by losing chlorophyll and subsequently dropping their leaves. These plants develop new leaves that are much thinner and have chloroplasts that are uniformly distributed throughout the lamina, obviously for better interception of light. Other species including palms and lilies respond to low light levels by changing color from green to yellowish, but without abscission. By remaining attached to the plant, these sickly leaves reduce the aesthetic value of the plant. Some nursery owners, anticipating the eventual transfer of plants to homes by customers, may put plants through a weaning period to acclimatize and prepare them for the home environment.

A variety of sunlight intensities are experienced in the home, depending on the season, architectural design of the house, and other landscape activities around the house or even nearby houses (Figure 11–10):

1. **Direct sunlight (full light).** A house that has no large trees in its immediate vicinity or structures that may block sunlight can receive 100 percent sunlight for parts of the day through windows that face east, west, southeast, and southwest.
2. **Indirect sunlight (filtered bright light).** When trees obstruct the direct sunlight, it enters the house after going through the leaves. Some windows have decorative curtains and blinds that also filter direct sunlight, making only a portion of its intensity (about 50 to 75 percent) available indoors.
3. **Bright light.** Bright light occurs near the areas where sunlight directly or indirectly enters the house. Such areas are less bright (about 25 percent) than the primary source.
4. **Medium light.** North-facing windows do not receive direct sunlight. Even windows facing east or west do not receive direct sunlight if heavily obstructed.

FIGURE 11–10 Natural light received in a room is influenced by factors such as the number and kinds of windows, the window treatment, the presence of trees near the windows, and the orientation of the house.



The lighting condition near these windows is of medium intensity (about 10 percent).

5. *Poor light.* As one moves away from windows into the center of the room, natural light intensity diminishes drastically (to about 5 percent). Room corners that are not near light sources are usually dimly lit. Poor lighting conditions can be contributed to by the interior design of the room. Dark colors absorb light, whereas lighter colors reflect it. A white wall reflects light to a plant placed in front of it. Furniture arrangement can create dark sections in the room.

Fortunately for home gardeners, most indoor foliage plants do not require high light intensities. However, when growing flowering plants such as azalea, chrysanthemum, geranium, and poinsettia indoors, high light intensity is desired for flower initiation. Plants such as cacti prefer higher light intensities to compensate for reduced photosynthetic surface from thickened leaves. Also fortunate for home gardeners is that many plants are quite tolerant of imperfect lighting conditions, at least for a period. Therefore, plants can be shifted around in a room without adverse consequences, as long as efforts are made to periodically provide the proper lighting conditions. The best approach, however, is to purchase plants that suit the lighting conditions one has or can provide, because shade-loving plants such as fern and aglaonema are less tolerant of improper lighting conditions (Table 11–6).

TABLE 11–6 Selected Plants Adapted to Various Light Conditions Indoors

Plants Adapted to Direct Natural Light (Place in South-Facing Window)

Norfolk Island pine (*Araucaria heterophylla*)
Croton (*Codiaeum* spp.)
Florist's chrysanthemum (*Chrysanthemum x morifolium*)
Florist's cyclamen (*Cyclamen persicum*)
Poinsettia (*Euphorbia pulcherrima*)
Dutch hyacinth (*Hyacinthus orientalis*)
English ivy (*Hedera helix*)
Christmas cactus (*Schulmbergia hybrids*, *Zygocactus truncatus*)
Azalea (*Rhododendron* spp.)

Plants Adapted to Low Light (Place in North-Facing Windows)

Dumbcane (*Dieffenbachia* spp.)
Lipstick plant (*Aeschynanthus* spp.)
Iron plant (*Aspidistra elatior*)
Staghorn fern (*Platycterium* spp.)
Snake plant (*Sansevieria trifasciata*)
Pothos (*Scindapsus aureum*) or (*Epipremnum aureum*)
Heart philodendron (*Philodendron scandens*)
Chinese evergreen (*Aglaonema commutatum*)
Peacock plant (*Calathea* spp.)
Corn plant (*Dracaena fragrans* 'Massangeana')

Plants Adapted to Medium Light (Place in East-Facing Windows)

Zebra plant (*Aphelandra squarrosa*)
Spider plant (*Chlorophytum comosum*)
Gold-dust plant (*Dracaena surculosa*)
Weeping fig (*Ficus benjamina*)
Indian rubber tree (*Ficus elastica*)
Baby's tears (*Helxine soleirolii*)
African violet (*Saintpaulia ionantha*)
Wax plant (*Hoya carnosa*)
Sentry palm (*Howea* spp.)

Phototropism

The response of a plant to nonuniform illumination, usually resulting in bending toward the strongest light.

When plants at home experience improper lighting conditions, they may grow spindly, have poor coloration (look pale) and small leaves, and exhibit **phototropism**. The shape and aesthetic value of plants can be drastically diminished when, in search of more light, plants turn their leaves in the direction of the source.

In split leaf philodendron (*Monstera deliciosa*), plants grown under dim light have unsplit leaves, whereas those grown under bright light have split leaves. Generally, plants with colored leaves (such as the red color of coleus) require more intense light to reach the chloroplasts masked by the red pigment. Similarly, variegated plants require more light to compensate for the lack of chlorophyll in certain parts. When grown in dim light, they do not variegate but show solid green color.

11.3.3 SUPPLEMENTARY LIGHTING (ARTIFICIAL LIGHTING)

Plants generally need twelve to sixteen hours of light per day for proper growth and development. Plants in the house receive a varying duration of light depending on how long people stay at home. Lights are turned on and off as people come into and leave the house. As such, plants may receive long periods of exposure to light on some days and little on others. Artificial lighting may be used in large houses for several reasons.

Decorative

A homeowner may desire to draw attention to specimen plants. These showcase plants may have unique and very attractive features and may be placed under a spotlight to emphasize their beauty. Lights and plants can be placed strategically to enhance the decor of a room.

Physiological

Plants need light to grow and develop. No plant can survive in darkness. As such, in dimly lit parts of the room, as well as in winter when natural light is least available, artificial light may be used to supplement natural light for plants to grow properly.

11.3.4 SOURCES OF ARTIFICIAL LIGHT

When additional lighting is required in a room, the type used is influenced by how it fits into the general decor of the room. When needed in a garden room, the styling may be compromised, but in the living room, styling of the light source is an important consideration for most people. There are three general sources of artificial light for indoor use—incandescent, mercury vapor, and fluorescent lights.

Incandescent Lights

Incandescent lights are commonly used in homes. The light they emit is high in orange-red and low in blue-violet wavelengths (Chapter 4). Even though they produce adequate light, the major disadvantage of this source of light is the tremendous amount of heat generated in the process of providing light. Only about 30 percent of the energy from an incandescent bulb is in the form of light, the remainder being given off as heat. When used for supplemental lighting, incandescent bulbs should be placed at a safe distance (depending on the power rating) to prevent scorching the plant. However, when placed too far away, incandescent light does little to help the plant, since most of its energy is heat and not light. This light source is hence largely decorative (e.g., spotlights). Flood-light models of incandescent lights are available and are more efficient. They also come in a variety of appealing styles.

Fluorescent Lights

Fluorescent lights are the most efficient of all sources and most recommended for houseplants. They are very energy efficient, cost less than the other types to operate, emit little heat, and can be placed close to plants without scorching them. They are available in a variety of colors, which adds to their decorative use at home.

Fluorescent tubes are also designed to emit different qualities of light. The spectrum of light usable by plants includes the violet-blue and red wavelength. Thus, it is important to take note of the spectrum on the label. Daylight fluorescent tubes provide mostly blue light and little red light. They are suitable for foliage plants. The best fluorescent tube lights for plants are those that provide a reddish hue, especially if flowering species are being grown. For extra light, the wide-spectrum light may be used. Extra light is desired by plants such as orchids, cacti, and pelargoniums. This requirement may be satisfied by using the very high output (VHO) fluorescent tubes. Cool white light, though poor in orange-red quality, provides excellent conditions for foliage plants to develop rich colors, branch more, and have a slow rate of stem elongation, resulting in fuller and more attractive plants. Unlike incandescent lights, which burn out suddenly, fluorescent lights age and lose intensity slowly. They have to be replaced after about four months of use.

Skylight

A skylight is not a light fixture but an architectural design strategy to allow more natural light to reach the interior of a room through the roof. For best results, the shell covering the opening in the roof should be constructed out of a material with *translucent* (not transparent) glazing. Translucent material allows the incoming solar radiation to be better distributed over a larger area without hot spots.

Caution: Even though light is very important for plant growth, it is better to provide too little than too much light. The danger of overexposure to light is greatest in summer. Note that when you place a plant in a window, only one-half of it, at best, receives full sunlight. Intense light may bleach or scorch the foliage of plants. Glass in a window is a filter of light preventing most of the ultraviolet rays from reaching the plant. When growing sensitive plants, one should be aware of their needs. As already indicated, variegated plants (e.g., *Hedera helix*) cease to variegate but instead produce dark-green leaves under light intensity lower than optimum. Other light-related disorders are discussed in Chapter 4.

11.3.5 TEMPERATURE

Houseplants generally prefer temperatures of between 18 and 24°C (64.4 and 75.2°F) for good growth and development. This condition often prevails in the average home in temperate climates. For most foliage ornamentals, a room night temperature of 21°C (70°F) is satisfactory, whereas growth is stalled at temperatures of 15°C (59°F). Flowering houseplants do well at 15°C (59°F) night temperatures. Even though plants may tolerate less-than-optimum temperatures above or below (10 to 30°C [50 to 86°F]), the danger to houseplants lies in the fluctuations in temperature. Night outdoor temperature may drop below freezing (0°C or 32°F), whereas indoor temperature may be 28°C (82°F) or higher. A change in temperature of more than 20°C (36°F) is detrimental to houseplants. As such, plants that are positioned close to windows or on windowsills run the risk of exposure to drastic temperature changes (warm inside and freezing outside) and may die as a result. Summer temperatures of 26 to 32°C (78.8 to 89.6°F) are tolerable for most indoor plants, provided the humidity is maintained at a high level. It is advisable to invest in a thermometer, preferably a maximum-minimum type, which helps determine the temperature fluctuations in the room.

Some caution in the care of houseplants can reduce the risk of loss to adverse temperature:

1. Keep humidity high in winter by periodically spraying plants with mist sprayers to keep microclimates humid.
2. Do not place plants in the path of drafts (from air conditioners or heaters). Some plants may benefit from the additional warmth from a radiator as long as it is not direct and the humidity level is high.
3. Windows and doors close to plants should be airtight to prevent unsuspected cold drafts in winter.
4. If plants must be placed close to windows, they should be protected by having a storm window installed to prevent cold chills at night.
5. When curtains are drawn at night during winter, be sure that the plant on the windowsill is inside of the curtain.
6. If you have flowers in the kitchen, avoid placing them near sources of heat (e.g., stoves and refrigerator tops).
7. Plants directly facing doorways are subject to crosscurrent air.

11.3.6 HUMIDITY

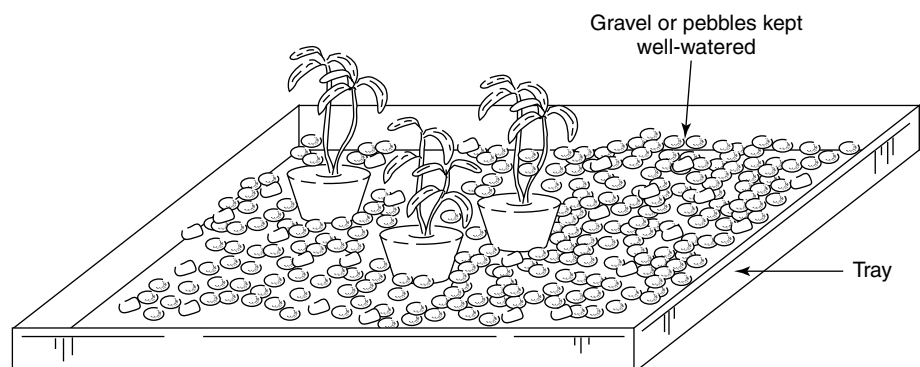
Humidity and temperature work together. Humidity, the relative amount of water vapor in the air, is measured by using a *hygrometer*, an instrument recommended for homes with plants. A high humidity level is uncomfortable for humans. Generally, a relative humidity (RH) of 60 percent is satisfactory for most houseplants. Many plants experience stress when RH is below 40 percent. Under such conditions, drying of leaf tips occurs in plants such as palms. Indoor RH is seasonal, being lower in winter than at other times. Plants with thick leaves are often able to tolerate low levels of humidity in the air, unlike those with thinner leaves.

11.3.7 PROVIDING SUPPLEMENTARY HUMIDITY FOR PLANTS

In winter, the use of heaters tends to cause indoor air to be dry. Dry air encourages excessive evaporation from surfaces. Humidity indoors can be increased by several methods:

1. *General humidification.* Provide additional humidity for the whole room by using a domestic humidifier.
2. *Localized humidification*
 - a. *Mist spraying.* Periodically, plants can be misted with water, but this practice provides only short-term effects.
 - b. *Pebble tray.* Potted plants can be placed on pebbles in a tray (Figure 11–11) and the tray watered (but not above the pebbles). This approach provides a more continuous humid microclimate. Pebble trays

FIGURE 11–11 A pebble tray may be used to keep the plants' microenvironment humid.



may be used for one pot or a group of several pots. Alternatively, a pot may be set on a wooden block placed in a saucer and treated like the pebble tray setup.

3. *Enclosed chamber.* For plants that are very sensitive to low humidity, enclosed glass or plastic chambers or bottles may be used to hold potted plants or grow such plants (as is done in a terrarium).
4. *Move plants.* Certain parts of the home have higher humidity levels than others (e.g., bathroom and kitchen). Plants may be moved close to these humid sections during the winter months.

Caution: Relative humidity and temperature work together. If the temperature is high, RH will be low. On the contrary, when RH is high and the temperature in the house drops, water will bead on the leaves. These droplets of water provide a humid environment for maintenance of disease organisms.

11.3.8 WATER

Water plays a very important role in plant nutrition. One of the most common problems in houseplant culture is overwatering. Plant species differ in their moisture requirements. Several factors determine the water needs of houseplants:

1. The room condition, which varies with the season, determines how plants must be watered. Warm or hot environments cause plants to lose more water than cooler environments.
2. Actively growing plants use more water than dormant plants.
3. Plants with thin leaves and larger leaf surfaces transpire more and thus need more water than other types of plants.
4. The container material plays a role in the moisture needs of plants. Plastic, styrofoam, and glazed containers retain more moisture in the growing medium than clay pots or unglazed containers. Plants grown in unglazed pots require frequent watering.
5. Plant growth media differ in their water-holding capacity. Sandy soils or those containing perlite drain more freely than those containing organic materials such as peat. Freely draining soils require more frequent watering than those with good water-holding capacity.
6. The size of the container in relation to plant size is also critical. When a large plant is grown in a small pot that can hold only a small amount of water at a time, more frequent watering is required. In addition, the roots of large plants in small pots become pot-bound, requiring repotting of the plant.

The greatest danger of overwatering is from watering according to a set schedule. It is safest to always determine that a plant needs water before providing it. If, a week after watering, the soil is still reasonably moist, further watering should be delayed. Symptoms of overwatering are wilting (in the presence of abundant moisture), yellowing of leaves, and rotting; symptoms of lack of moisture include drooping of leaves and wilting. Although these symptoms are stress alerts, it is best to avoid them. Plants cannot be revived after a certain stage of wilting, especially in the case of plants with thick leaves. Sometimes, when the plants are revived, portions of the leaves (the edges) may be permanently scorched, leading to disfigured leaves and decreased aesthetic appeal. Physiologically, alternating between drought and adequate moisture conditions (just like repeated freezing and thawing of food) offsets developmental processes in the plant including reproductive processes and may cause tissue death.

Many different types of equipment are available for measuring soil moisture. A moisture meter may be purchased by the avid gardener. For most people, a simple moisture indicator that changes color based on the dryness of the soil is satisfactory. There are other ways in which soil moisture can be determined without using

instruments, although one of them is not soil surface dryness. Most plants are overwatered because growers look at the soil surface without knowing what is going on beneath it and decide that watering is required. It is best to stick a finger into the potting medium to a depth of about 1 inch or more (or use a piece of stick) to determine the stickiness or moisture level of the soil.

11.3.9 HOW MUCH WATER TO PROVIDE

Plants have different water needs. It is a waste of resources and a danger to plants to supply more water than is needed. For a particular plant, the amounts applied may be varied depending on the growth phase. In terms of quantity applied, plants may be watered in these general ways:

1. *Plentifully (or liberally).* In watering liberally or plentifully, the potting medium is kept constantly moist. When water is needed, plants may be drenched with water until the medium can hold no more. At this stage, excess water collects in the drip tray or saucer. This excess water should be discarded. Drenching can be done from the top or by placing the pot in a container of water and allowing it to soak up water until it can take in no more. The pot is then removed from the water.
2. *Moderately.* When water is applied in moderate amounts, only a small amount of excess water drains into the saucer. If a grower is using the soaking method, only a little water should be added to the container at a time. Water is added continually until the surface of the soil is moist. The plant is watered again when the soil feels slightly dry.
3. *Sparingly.* Watering sparingly keeps the growing medium only partially moist. Water never drains out of the pot. The plant is rewatered when most of the soil is dry.

Caution: These three general watering regimes are not alternatives. The method chosen for a situation depends on the specific needs of the plant, the conditions under which it is growing, and its growth phase.

11.3.10 ROLE OF PLANT GROWTH CYCLE IN WATER NEEDS

The plant growth cycle is often overlooked in the management of houseplants. Deciduous plants have a visible and predictable alteration between active growth (spring to fall) and rest period (winter), because they shed their leaves in the cold season. Without leaves, it is not difficult to guess that the plant does not need as much nutrition (water and minerals) as it does when it has leaves. Many bulbs and corms also have periods of rest during which their aboveground portions die back. However, many plants also have rest periods in their biological clocks that are less obvious. These species do not exhibit any dramatic signals to prompt the grower to make the necessary adjustments in management practices. These evergreen species, like most foliage houseplants, retain their foliage year-round. Some horticulturalists recommend that many indoor plants be forced to rest in winter when daylight is reduced. Induced resting may be accomplished by reducing the amount of water supplied and discontinuing fertilizer application. The best approach, however, is to consult the growing instructions supplied with plants or seeds purchased from a nursery.

11.3.11 METHODS OF APPLYING WATER

Water may be applied to plants by using any convenient container such as a cup. However, it is advisable and most convenient to use a watering can to water houseplants. Very inexpensive, lightweight plastic watering cans with long and thin spouts may be purchased from supermarkets. A long spout enables watering without spilling and splashing onto leaves. It also increases the maneuverability of the operator so that plants positioned in hard-to-reach places are readily watered. For homes with glasshouses,

garden rooms, atriums, or a large collection of plants, a watering hose with an on/off control switch at the nozzle may be more convenient. There are two basic methods of watering houseplants:

1. *Water soil directly from above.* In this method, care is taken not to splash water on the leaves (Figure 11–12). The soil level in the pot should permit a good amount of water to collect on top without spilling over.
2. *Water soil from below.* Potted plants may be placed in a saucer or container into which water is poured (Figure 11–13). Water is then slowly absorbed through the drainage holes in the bottom of the pot.

As much as possible, plants should be watered carefully to avoid wetting the plant leaves. If the water is hard, it leaves unsightly marks on the leaves. Also, if fertilizers are applied through the irrigation water, marks from the salts are left on leaves if splashing occurs. Water on leaves may also create humid conditions in which disease-causing organisms thrive. Some plants, such as bromeliads, can tolerate water on the foliage. When watering plants, lukewarm water should be used. Tap water in some places can be very cold. The water should also be soft, since plants such as camellias are sensitive to salts in water.

When plants are going to be left unattended for extended periods, such as while a homeowner is on vacation, creative methods of watering should be devised to avoid wilting of plants. For example, plants may be enclosed in a plastic bag to retain moisture (Figure 11–14). A wick system may also be used (Figure 11–15).

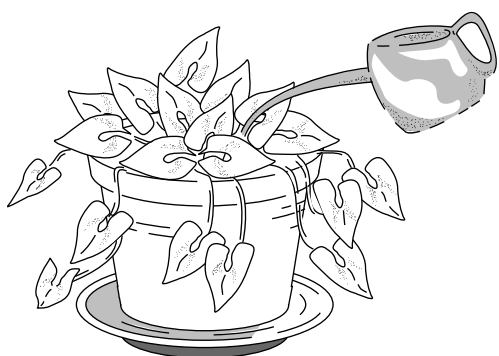


FIGURE 11–12 Watering a potted plant from above.



FIGURE 11–13 Watering a potted plant from below.

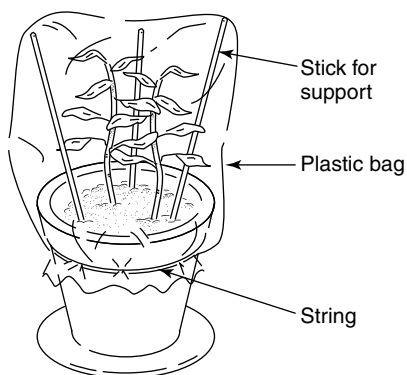


FIGURE 11–14 A potted plant enclosed in a plastic bag to maintain high humidity.

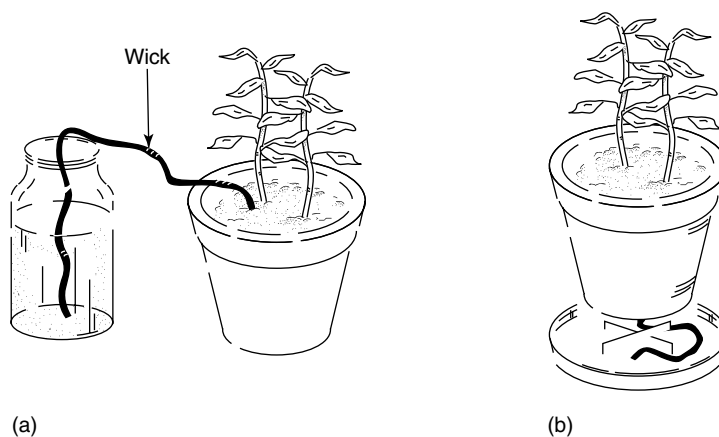
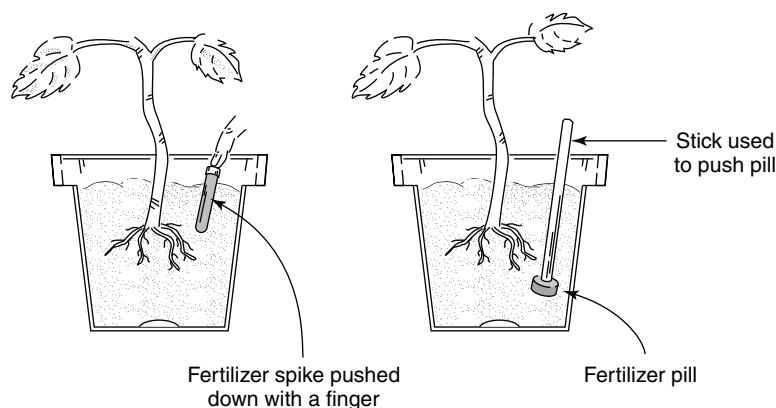


FIGURE 11–15 Watering potted plants by using a wick (a) inserted into the pot from above from a feeder bottle and (b) inserted through the drainage hole in the bottom of the pot.

FIGURE 11–16 Using fertilizer spikes and pills in fertilizing potted plants.



11.3.12 FERTILIZING HOUSEPLANTS

All plants need balanced nutrition to grow, develop properly, and produce well. The nutrients in the potting soil are gradually depleted as the plant grows and develops. Unlike field plants, whose fertilizer needs usually consist of only macronutrient elements (nitrogen, phosphorus, and potassium), potted plants need both macro- and micronutrients as part of a fertilizer program. Both types of nutrients are required because whereas mineral soil has some native nutrients, greenhouse soilless mixes are often deficient in nutrients, especially micronutrients.

Fertilizers for indoor use are available in several forms—solids, liquids, powders, crystals, or granules. Powders and crystals, which are dissolved in water before being applied to the soil, are called *soluble fertilizers*. Fertilizer sticks and spikes are examples of solid fertilizers packaged in cylindrical shapes similar to pencils that are inserted into the soil for gradual release of their nutrients (Figure 11–16). Such fertilizers may also be packaged as pills. Specially coated fertilizer granules are commonly used in feeding houseplants. These solids are called *slow-release fertilizers*. Finally, fertilizers may be applied in liquid form as foliar sprays to plant leaves. While all plants grown in soil respond to fertilizers placed in the growing medium, foliar application is especially beneficial to plants such as epiphytes (e.g., bromeliads), which absorb little nutrition through their roots. The concentration of foliar sprays should be carefully selected to avoid scorching the leaves.

Timing of feeding is essential in houseplant nutrition. It should be remembered that other growth factors (e.g., light, temperature, and water) must be adequately supplied for fertilizers to be effective. Some home growers misdiagnose plant problems, thinking a poorly growing plant is starving when it actually is overwatered or not receiving adequate light or warmth. As previously mentioned, fertilization should take into account the growth phases of the plant. When a plant is growing actively, it needs more nutrition; when dormant, nutrients should be reduced or eliminated altogether.

11.4 SEASONAL CARE OF HOUSEPLANTS

11.4.1 SEASONAL CHANGES

The four seasons are characterized by certain key changes in meteorological factors, which impact how houseplants are cared for from one season to another. Seasonal care of houseplants also depends on the plant growth cycle, among other characteristics. The key seasonal changes are as follows:

Spring

The key changes in weather during the spring season that have a significant bearing on how houseplants are cared for are increasing day length and gradual rise in temperature.

The photoperiod affects when the house light is turned on. The air can be relatively humid because of the rainfall.

Summer

During the summer season, light intensity increases to a peak, while temperature also rises to maximum levels. The air can be dry and hot. Homeowners maintain comfortable room ambience by turning on the air conditioner. Some people make use of the bright outside light by parting the curtains or opening the window blinds. The danger to plants may be the intense light from the sun.

Fall

During the fall season, day length shortens while temperature decreases. Homeowners begin to turn on the heating system to keep warm.

Winter

Day length is at its minimal value during winter. Similarly, room temperature drops to its lowest during the year. Indoor heating is at its maximum. Danger to plants comes in a variety of ways. Plants in window sills may be exposed to temperature extremes, very cold on the outside of the window and very warm temperature inside the home. If the curtain is pulled over such that the plant is between the window and the curtain, it might suffer severe winter damage. Further, winter plant damage may come to plants placed in the way of a draft when the door is opened or when placed on/near heating vents or space heaters.

11.4.2 SEASONAL WATERING AND FERTILIZATION OF INDOOR PLANTS

Evergreen Plants

Evergreen plants retain their leaves year-round. Evergreen plants need normal watering in spring, summer, and fall. Watering should be reduced during the winter months. Similarly, evergreen plants should be fertilized at regular rates in spring, summer, and winter, reducing the rates in winter.

Deciduous Plants

Deciduous plants shed their leaves at some point in their growth cycle, starting in fall and losing them all in winter. Fresh leaves appear in spring. During this time, plants should be moderately watered and fertilized. As vegetative growth peaks in summer, watering and feeding should be increased. Fertilizing should be stopped in fall, while watering is reduced in fall and winter. As the plant rests in winter, the soil should be kept just moist enough to keep the plant from dying.

Annual Plants

Annual plants complete their life cycle in one growing season. If the plants are started in spring, the young plants should be moderately watered and sparingly fertilized. As the plants grow, watering should be plentiful while fertilizer rates are increased for optimum vegetative growth and flowering, where applicable. Annual plants will begin to die as fall begins. As the leaves begin to drop, watering and fertilizing should cease.

Bulbs and Tuberous Species

Bulbs and tuberous species are characterized by a growth cycle in which there is a distinct dormant period. These plants grow actively in spring and need to be well watered and fertilized during this period. However, the aboveground parts cease to grow and die during summer as plants enter into a period of dormancy. Active growth resumes in fall when the underground structures begin to sprout. Sprouting tubers should be watered

sparingly but not fertilized yet. As winter arrives, vegetative growth increases, reproductive growth starting where applicable. Watering and fertilizing should be increased to a moderate level during this time.

11.5 POTTING MEDIA

Potting media are discussed more fully in Chapter 4. Potting mixtures differ widely in constitution. Some commercial mixes are designed for specific purposes (e.g., mixes for use in the terrarium or for seed germination) and others for general purposes. It is critical that a potting medium be sterilized to kill pathogens. The mixes may be soil based (i.e., they include natural soil) or soilless (containing no natural soil ingredients). The grower can sterilize his or her own homemade medium by placing an aluminum-covered tray of the mix in a conventional oven and baking at 82°C (179.6°F) for about an hour. Such an undertaking can be very messy. Soilless mixes are lighter in weight and easier to handle than soil-based mixes, but they lack nutrients. When used for potting top-heavy plants, the plants can be toppled easily. A simple homemade recipe for a mix may consist of the following:

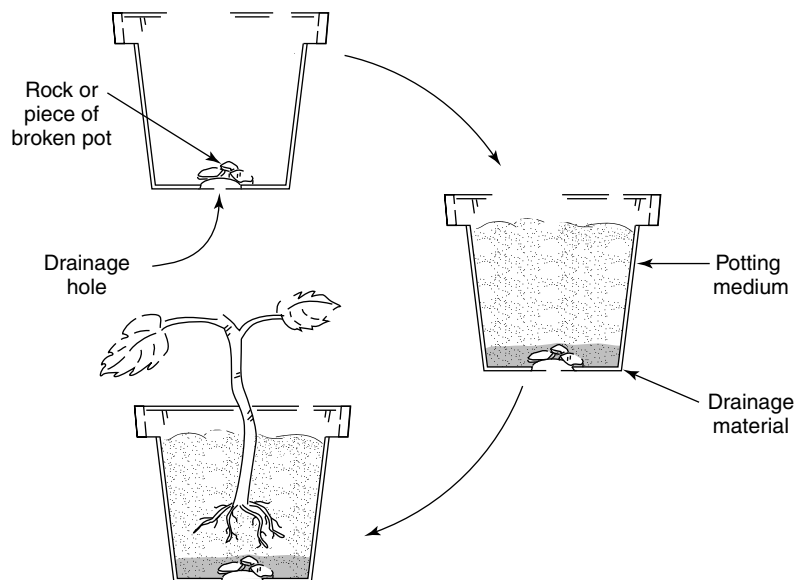
1. One part sterilized soil plus one part medium-grade peat moss plus one part fine perlite
2. One part coarse peat moss plus one part medium-grade vermiculite plus one part medium-grade perlite

These mixes should be supplemented with balanced fertilizer.

11.6 POTTING PLANTS

After the appropriate potting mixture has been determined and purchased or prepared, and the right container chosen, the next step is to pot the plant. The drainage hole or holes in the bottom of the pot should be partially covered with pieces of broken pot (crock) or small stones. Care should be taken not to plug the hole (Figure 11–17). Potting mix is then added to the container. A hole is made in the soil to receive the plant roots and then

FIGURE 11–17 Steps in potting plants.



patted firm to keep the plant erect. Additional soil, if needed, should be added, but at least 1/2 to 1 inch (1.3 to 2.54 centimeters) of space should be left at the top of the soil to hold water during watering (sometimes called the *headspace* of the container). It should also be noted that the soil will settle with deep watering.

11.7 REPOTTING

11.7.1 WHEN NEEDED

Repotting is actually transplanting from one pot to another. Sometimes plants are repotted because a grower desires to change containers for cosmetic or aesthetic reasons. However, there are certain times during the growth of a plant when it needs to be repotted for better growth and development. One such occasion and perhaps the chief reason for repotting is when a plant grows too large for its container. When this happens, the roots become **pot-bound** (roots grow over each other and around the bottom of the pot, forming a ball) (Figure 11–18). Many roots at this stage are not in contact with soil and thus not aiding in nutrient or water absorption. Pot-bound plants grow slowly even with good nutrition and watering. Roots often grow through the drainage holes in the bottom of the container. To find out whether a plant is pot-bound, it should be removed, along with the soil, by positioning its stem between two fingers of one hand and turning the pot over into the palm. Gently tapping on the bottom of the pot or tapping the pot against the edge of a table can help to dislodge the soil. In the case of larger plants, a small block of wood may be used to tap the side of the pot while it is lying on its side. A sharp edge (e.g., the blade of a knife) may be run around the inside wall of the pot to break loose any attachment to the walls. Watering plants before repotting is recommended to aid in their removal from the pot.

Pot-bound

Growth of roots over each other and around the bottom of the pot as a result of limited space.

11.7.2 CHOOSING A POT OR CONTAINER

The plant height (size) in relation to pot size is important for aesthetic reasons. The grown plant height should be about two times the pot height. An oversized pot not only wastes soil mix but also increases the risk of overwatering to the detriment of the small plant. Pots come in different shapes, sizes, and materials. The strategy of repotting involves changing to a bigger pot size in a stepwise fashion.

Old pots should be cleaned and disinfected (use household bleach or germicidal soap) before reuse. When cleaning glazed clay pots, they should be soaked in water for several minutes to remove all air bubbles in the clay. When dry clay pots are used for repotting, the clay tends to absorb moisture rapidly from the soil.



FIGURE 11–18 An extreme case of pot-bounding. (Source: Peter Anderson © Dorling Kindersley)

Containers come in all shapes and sizes. In effect, any receptacle may be used to grow plants, provided adequate provision is made for drainage and the container is convenient to use. Pots are also chosen to complement the design of the room.

Container Materials

There are two basic materials used in making horticultural pots. Each has advantages and disadvantages.

Clay Clay (or earthenware) used to be the industry standard for pots but has been replaced with newly developed material. Clay, being a natural material, “breathes,” or is porous, allowing water to evaporate from its surface. As such, it reduces the danger of waterlogging from overwatering. Clay pots are heavier, more sturdy, and able to support large plants without toppling over (Figure 11–19). However, clay pots are also bulky to handle and breakable, requiring care in handling. Because it is capable of absorbing mineral salts and water from the medium, the surfaces of clay pots often show unsightly whitish marks from salt deposits. During repotting or topdressing, these marks should be scrubbed off by using household bleach and then rinsed in vinegar. Such marks are not associated with glazed clay pots.

Pot-bound root growth occurs more rapidly in plants grown in clay pots than those in plastic pots because the porosity of clay allows air to reach plant roots more readily than those in plastic (where air is obtained from the open top only). Roots thus tend to grow rapidly toward the wall of the pot where, upon meeting the obstacle, they begin to circle around on the surface of the wall.

Plastic Plastic pots are very popular today and are available in a wide range of colors, thickness, durability, shapes, and sizes (Figure 11–20). Plastic pots are generally less breakable than clay pots. Even though molded polystyrene pots are used in some situations, hard plastics are most common because they are lightweight and easy to handle. Plant roots grow more evenly in a plastic container. One problem with this synthetic material is that it is not porous and thus plants grown in plastic pots are prone to waterlogging because they lack the ability to absorb moisture and lose it through evaporation. Although overwatering plastic-potted plants may be a problem in winter when drying is slow, plastic pots are advantageous in summer when water stress is most common.

Plastic pots are intolerant of the high temperatures needed for sterilization and thus are best sterilized by using chemicals. Pots may be soaked for about ten minutes in a commercial disinfectant solution (e.g., Florafix or Green-Shield), rinsed in water, and then air dried. This chemical sterilization is not as effective as steam sterilization. For better results, plastic pots should be washed to remove all dirt before being treated with chemicals. Plastic pots are also readily toppled when plants grow larger.



FIGURE 11–19 Clay pots. (Source: George Acquah)



FIGURE 11–20 Plastic pots. (Source: George Acquah)

Other Materials Apart from clay and plastic, another synthetic material called *styrofoam* is used in the horticultural industry for plant culture. This material is known for its insulation quality and hence is used especially when keeping the soil warm is a priority.

Shapes and Sizes

The shape of a pot is largely a matter of personal preference. Most pots have a circular lateral cross section, but other shapes occur (Figure 11–21). Sometimes rectangular pots are used to grow mass displays of plants that hang from places such as the balconies of apartments.

In terms of size, there are four general types of pots:

1. **Standard pots.** Standard pots vary in size but are characterized by having a height that equals the pot width. This shape is not suitable for growing tall plants since such pots are then prone to tipping over.
2. **Azalea pots.** Many flowering plants are grown in azalea pots. They are more stable than standard pots because they stand three-fourths as high as they are wide.
3. **Bulb pots.** Bulb pots are also called *half pots* because they stand half as high as they are wide. They are widely used in the propagation of plants. They may be used to grow plants with shallow roots to maturity or plants that may be displayed in mass form (e.g., zebra, tradescantia, daffodil, hyacinth, and tulip).
4. **Rose pots.** Rose pots are one and a half times as tall as they are wide and are used for growing deeply rooted plants.

Within each type, pots are referred to by their height (e.g., 6- or 9-inch [15.2- or 22.9- centimeter] pots). Nurseries that produce bedding plants and vegetable seedlings for sale often grow these in small peat pots or plastic containers in packs of six or twelve plants (*community packs*) (Figure 11–22).

Some plants may be repotted or shifted several times before they are settled in a more permanent container. When plants grow too large for the standard sizes of pots, they may be transplanted to larger containers called *tubs* that may be made out of wood or plastic (Figure 11–23). Even though changing pot sizes as plants grow may be an unpleasant chore, it is safer to “pot up,” progressively increasing the pot size as the plant increases in size, than to grow plants in pots that are too small. A small plant in a large pot not only looks awkward but also is prone to overwatering and possibly death. Further, it is a waste of the potting medium.

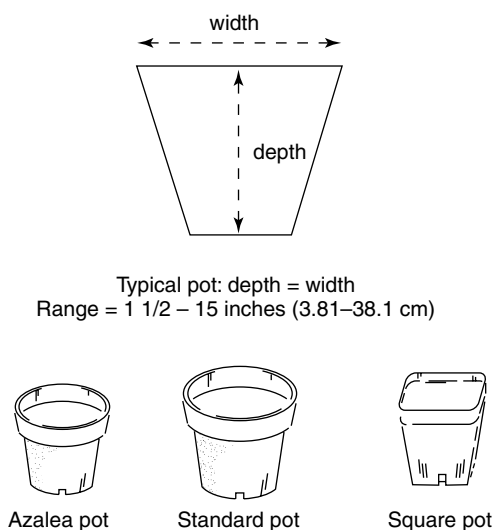


FIGURE 11–21 Pot shapes and sizes.

Standard Pot

A pot design in which the height equals the width.

Azalea Pot

A pot design in which the height equals three-fourths of the width.

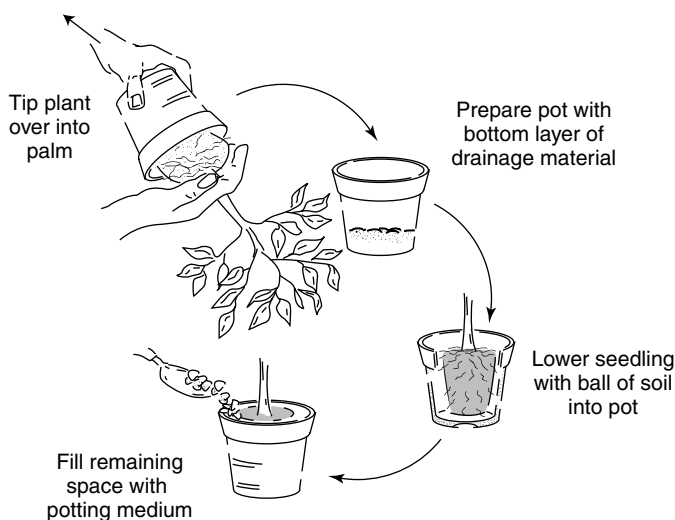


FIGURE 11–22 A community pack of seedlings. (Source: George Acquah)

FIGURE 11–23 Large container. (Source: George Acquah)



FIGURE 11–24 Steps in repotting large plants.



11.7.3 REPOTTING PROCESS

In repotting, the drainage hole in the container should be covered, as described earlier. As insurance against overwatering, the bottoms of pots with drip pans or those placed in saucers should be lined with gravel or pebbles. The potting mix should be slightly moistened before use. First, some soil is placed at the bottom of the pot. The plant is then removed, along with a ball of soil from the old pot, and all pot-bound roots straightened out before setting on the moist soil in the receiving pot. The remaining space is filled with more of the fresh potting medium (Figure 11–24). In some cases, adding more soil to fill up the empty spaces may be cumbersome. In such situations, the old pot may be placed in the new one and the space around it filled to create a mold into which the ball of soil from the transplant will fit. The plant should be placed no deeper than the depth used in the previous pot.

11.7.4 TOPDRESSING

Topdressing

Applying fertilizer to the surface of the soil while the plants are growing.

The practice of **topdressing** in potted horticultural plants involves providing plants with fresh growing media without transplanting when the biggest pot size desired or available has been used. It entails scraping off about 1 to 2 inches (2.54 to 5.1 centimeters) of topsoil and replacing with a fresh soil mix. Where it has been determined that roots are pot-bound, they should be pruned to remove the excess roots before topping with fresh soil. Pruning and topdressing should be done with care to avoid damaging the plant.



(a)



(b)

FIGURE 11–25 Support for plants. (a) Wooden stake, (b) wire cage. (Source: USDA)

11.8 PROVIDING SUPPORT

Many flowering houseplants are freestanding and self-supporting. However, plants sometimes need additional support when they produce heavy flower heads that cause the stem to bend (e.g., cineraria and tomato). Other plants (e.g., fatshedera) may have slender stems that need additional support. Another instance where houseplants may need reinforcement in their support system is when they grow large but have brittle stems (e.g., impatiens).

In all of these instances, additional support may be provided by tying the weak stem to a stake with a string. Bamboo provides strong stakes. It may be split into smaller pieces and remain capable of providing good support. Whenever necessary, several stakes may be used to support a single plant in a pot. To keep the aesthetic value, stakes and twine used for tying should be positioned strategically and all loose ends neatly removed. Knots should not be tied too tightly around the stem. The idea is to provide additional support, not to bunch branches together.

Climbing plants (e.g., ivy, depladenia, and hoya) are known to produce vines. The grower should decide whether the vines will be allowed to hang freely or whether the plant will be encouraged to climb on some support (e.g., a wall or pole). The grower may purchase wire frames designed in a wide variety of shapes for *training vine plants* (e.g., philodendron and cissus) or create his or her own support frame (Figure 11–25). When plants are trained on supports, they must be tied, as when using stakes.

11.9 DISEASES AND PESTS OF HOUSEPLANTS

When it comes to houseplant diseases and pests, the key is to prevent their occurrence in the first place. Since plants cohabit with humans in small, enclosed spaces, diseases and insect pests should not be allowed to infest the environment. It is most undesirable to be confronted with a situation in which pesticides, which are toxic to humans as well as the pests they control, must be used in the house.

Diseases and pests of houseplants are often traceable to improper growing conditions (e.g., poor lighting, improper temperature, insufficient or excessive moisture, poor nutrition, still air, and high humidity). As such, before a homeowner scrambles to implement disease-control measures, it is best to first check whether plants are receiving proper care. Maintenance of strict phytosanitary conditions in the home is important.

Where possible, leaves should be cleaned to remove dust, grease, and environmental pollutants that settle on them. Plants may be cleaned with plain or soapy water, and care should be taken not to leave drops of water on parts of the plant after washing. Diseases and pests of houseplants are discussed more fully in Chapter 8.

11.10 COMMON SYMPTOMS OF ILL HEALTH IN HOUSEPLANTS

Houseplants under stress from inadequate or improper levels of nutrition and other growth factors may exhibit one or more of the following common symptoms associated with ill health in plants:

1. *Yellowing of leaves (chlorosis).* Yellowing of leaves is usually a sign that plants are in distress. When older leaves yellow, it could be due to nitrogen deficiency. However, any disease that interrupts the flow of nutrients may cause leaves to yellow. When young leaves yellow, the plants may be under stress from poor drainage. When both young and old leaves yellow, the cause could be poor lighting or drought (underwatering). Chlorosis occurring with leaf drop could signal cold temperatures or poor aeration due to waterlogging.
2. *Stunted growth.* Whenever plants show stunted growth with small leaves and poor color, the condition could be due to one or a combination of the following: moisture stress, improper temperature, roots that are pot-bound, and restricted growth.
3. *Foliar burns.* Burns on leaves—when they occur as patches without any definite pattern—could be caused by fungal pathogens or could be the result of burns from foliar application of an insecticide. When plants have experienced severe drought, they may recover but the tissues at the edge may die, especially in young leaves. When the edge burn occurs in older leaves, it could be caused by excessive fertilization, leading to accumulation of salts in the soil. Other symptoms and possible causes are described in Table 11–7.

TABLE 11–7 Common Problems of Houseplants and Their Management

<i>Water-Related Problems</i>	
Symptom:	Plant wilting; wilting is intensified with continued irrigation
Possible cause:	Medium is saturated or drainage is poor
Suggested action:	Repot properly for improved drainage; reduce frequency of watering
Symptom:	Plant wilting but recovers with watering
Possible cause:	Medium was left to dry for too long; plant may be pot-bound
Suggested action:	Increase watering frequency; repot into a larger pot
Symptom:	Leaf edges or tips appear scorched
Possible cause:	Insufficient or infrequent watering; medium left dry for a long period
Suggested action:	Water more frequently and more thoroughly each time
Symptom:	Plant is stunted in growth; leaves are of reduced size
Possible cause:	Insufficient watering frequency and quantity of water applied
Suggested action:	Water plant at proper frequency and apply adequate water each time
<i>Light-Related Problems</i>	
Symptom:	Etiolated plant growth
Possible cause:	Insufficient light intensity
Suggested action:	Relocate plant into brighter area of room or provide artificial supplemental lighting
Symptom:	Chlorosis (especially in older plants)
Possible cause:	Insufficient lighting

(Continued)

TABLE 11–7 Common Problems of Houseplants and Their Management (Continued)*Light-Related Problems*

Suggested action:	Relocate to brighter part of room
Symptom:	Bleaching or discoloration of leaves
Possible cause:	Plant is intolerant of direct sunlight
Suggested action:	Relocate to part of room with lower light condition
Symptom:	Flowering is poor or drastically reduced
Possible cause:	Low light intensity
Suggested action:	Relocate to area with proper light condition
Symptom:	Leaf abscission accompanied by chlorosis
Possible cause:	High light intensity
Suggested action:	Relocate plant to lower light area

Nutrition-Related Problems

Symptom:	Uniform chlorosis of leaves on the whole plant
Possible cause:	Nitrogen deficiency
Suggested action:	Apply or increase rate of application of nitrogen fertilizer
Symptom:	Stunted growth of plant
Possible cause:	Inadequate fertilization
Suggested action:	Apply fertilizers
Symptom:	Leaf tips and edges brown or scorched
Possible cause:	Excessive fertilization
Suggested action:	Flush excess salts with large quantities of water; adjust fertilizer rate

Temperature-Related Problems

Symptom:	Slow growth
Possible cause:	Low temperature
Suggested action:	Place in warmer area of room
Symptom:	Leaf abscission
Possible cause:	Drop in temperature
Suggested action:	Protect plant from cold, chilling temperature
Symptom:	Chlorosis with abscission
Possible cause:	High temperature
Suggested action:	Lower temperature; do not locate near heating system

Pathogenic Problems

Symptom:	Gray, fluffy mold
Possible cause:	Gray mold attack due to high humidity
Suggested action:	Reduce residual moisture on leaf; mist spray only lightly; aerate; remove affected parts
Symptom:	Leaf spot
Possible cause:	Fungal or bacterial infection due to high humidity or residual moisture on foliage
Suggested action:	Do not mist spray foliage; keep leaves dry by watering media without wetting foliage; remove affected leaves
Symptom:	Blackening and rotting at the base of the stem
Possible cause:	Blackstem rot from gray mold attack; results from overwatering or poor drainage of potting medium
Suggested action:	Remove plant and examine root; if rot is extensive, discard; otherwise treat with fungicide and repot in well-draining medium
Symptom:	Stunted growth; mottling of leaves; distortion of leaves
Possible cause:	Viral infection; due to attack of sucking insects (e.g., aphids)
Suggested action:	Destroy infected plant
Symptom:	Healthy-looking plant starts to wilt in spite of watering and fertilizing; roots are knotted
Possible cause:	Root-knot nematode attack
Suggested action:	Destroy plant and discard potting medium; use sterilized medium for potting plants

Symptom:	A fine web coating on leaf undersides
Possible cause:	Attack of spider mites; favored under hot, dry air conditions
Suggested action:	Mist plant; cut affected part and discard
Symptom:	Holes in leaves
Possible cause:	Attack of chewing insects (e.g., caterpillar and earwig)
Suggested action:	Remove pest and destroy
Symptom:	Rolling of leaves
Possible cause:	Leaf roller attack
Suggested action:	Locate and destroy moths

11.11 COMMON HOUSEPLANTS AND THEIR CARE

[COLOR PLATES—see color plate 13–16 for photos]

The care of selected houseplants is briefly summarized in this section. The color photos corresponding to these plants are found in color plates 13 to 16.

1. Aluminum plant (*Pilea cadierei*)
 - Prefers medium light; place in east of west window
 - Water frequently and thoroughly
 - Keep in cool temperature
2. Peacock plant (*Calathea roseopicta*)
 - High light
 - Moist soil and high humidity
 - High temperature
 - Repot annually and clean leaves frequently
3. Umbrella plant (*Cyperus albostratus*)
 - High light (direct sunlight), keep moist (place in saucer with water), high humidity
 - Maintain average temperature and cool night temperature
 - Cut plant to base if it appears rugged
 - Propagate by leaf bud cuttings, suckers, or seed
4. Variegated Swiss cheese plant (*Monstera deliciosa*)
 - Medium light (bright indirect)
 - Dry out soil between watering
 - High temperature (in 80s) during the day
 - If light is dim characteristic holes and slashes develop poorly
 - Needs support, hence plant in a large pot
5. Zebra plant (*Aphelandra squarrosa*)
 - Place in full light, or filtered in south window
 - Water frequently and thoroughly
 - Prefers high temperatures
 - Fertilize every two months
6. Blushing bromeliad (*Neoregelia carolinae*)
 - Place in bright light
 - Water regularly
 - Keep temperatures cool
7. Chinese evergreen (*Aglaonema*)
 - Place in medium light in west or east window
 - Variegated forms lose their color under low light

- Keep soil moist all the time
 - Place on pebble tray for high humidity
 - Keep temperature around the 80s
 - Tolerates pot-bounding
 - Propagate by rooting leaf in water, by stem cutting, or air layering
8. Bird-of-paradise (*Strelitza reginae*)
- Bright light (full sun) in fall and winter; medium (indirect) light in spring
 - Let soil dry between watering
 - Prefers moderate temperatures
 - May take up to ten years before flowering
9. Madagascar dragon tree (*Dracaena marginata*)
- Prefers bright light (full sun) in winter; tolerates low light
 - High humidity for good leaf growth
 - Mist often
 - Keep daytime temperatures high
 - Propagate by layering or stem cutting
10. Jade plant (*Crassula ovata*)
- Place in high light (south window)
 - Let dry between watering; excess moisture causes rot; soil should be well drained
 - High temperatures preferred
 - Pot-bounding stimulates flowering
 - Pinch growing tips to produces branching
11. Corn plant (*Dracaena fragrans* 'Compacta')
- Place in bright, indirect light away from direct sun
 - Keep soil moist and mist often to keep humid
 - Tolerates cool and warm temperatures
 - Pinch tips for a bushy growth
 - Clean leaves with tepid water
 - Propagate by stem cutting or air layering
12. Rubber plant (*Ficus elastica* 'Robusta')
- Medium bright light (indirect sunlight)
 - Tolerates low light
 - Mist frequently to maintain high humidity
 - Let soil dry between waterings
 - Water thoroughly and then drain and let dry
 - Clean leaves with moist cloth
13. Asparagus fern (*Asparagus umbellatus*)
- Prefers high light (full sun)
 - Soil should be kept moist
 - Keep temperature above 50°F
 - Prune often to keep it in shape.
 - Propagate by division; black seeds produced may also be used
14. Chrysanthemum (*Chrysanthemum indicum*) Mums (*Dendranthema grandiflora*)
- Prefers high light in vegetative growth and medium light in blooms
 - Water moderately; keep soil moist
 - Day temperature is about 50–60°F
 - Cut stems back after blooms to about four inches
 - Pinch stem tips to produce a fuller bushy plant
 - Propagate by stem cuttings

15. Aloe (*Aloe Vera*)
 - Prefers high light (place in south window)
 - Can bloom if light is intense
 - Do not overwater
 - High daytime temperatures needed
 - Fertilize moderately on a monthly basis
 - Propagate by offsets, cuttings, or division
16. Peace lily (*Spathiphyllum wallisii*)
 - Prefers medium light (bright indirect); intolerant of full sun
 - Maintain high humidity and moist soil
 - Temperature should be kept around 80°F during the day
 - Yellowing leaves should be removed
 - Propagate by dividing or seed
17. Snake plant (*Sansevieria trifasciata*)
 - Grows well in medium light (bright, indirect sunlight); tolerant of dim light
 - Drench and drain and let dry between watering; drought tolerant
 - Prefers high room temperature
 - Clean leaves with moist cloth periodically
 - Propagate by cuttings, offset, or rhizome division
18. Swiss cheese plant (*Monstera oblique*)
 - Bright light promotes characteristic windowed leaves
 - Can grow on totem poles or in baskets
 - Low water requirements; keep dry between waterings
 - Prefers moderate temperatures
19. Friendship plant (*Pilea involucrata*)
 - Prefers light shade or medium light
 - Keep soil moist
 - Keep temperatures moderate
20. Poinsettia (*Euphorbia pulcherima*)
 - Place in south window for high light when color is developed
 - Water well but keep dry between waterings
 - Keep temperature moderate during the daytime
 - Cut plant back to about eight inches
 - To have color during next season, place plant in darkness (short photoperiod) from 5 P.M.–8 A.M. for about thirty days starting on October 1
21. Easter lily (*Lilium longiflorum*)
 - When in bloom, keep in medium light (bright, indirect sunlight)
 - Water well but keep dry between waterings
 - Prefers cool temperature during bloom
 - Cut the stalk after plant dies, dig bulb, clean and store in cool dry place for planting in early fall
 - Propagate by scales
22. Boston fern (*Nephrolepis exaltata* ‘Bostoriensis’)
 - Place in east window for medium light
 - Water well but let soil dry between waterings; mist especially during the summer
 - Temperature should be no more than 75°F for best growth
 - Supply fertilizers sparingly
 - Propagate by division or runners; mature spores may also be used
23. Umbrella tree (*Schefflera arboricola* ‘Luciana’)
 - Place in medium light (bright, indirect sunlight); dim light produces reduced foliage
 - Keep soil dry between watering and mist frequently

- Prefers high temperatures
 - Prune as necessary to keep in shape
- 24.** Cyclamen (*Cyclamen persicum* ‘Sylvia’)
- Place in east window for medium light
 - Avoid watering leaves directly (promotes crown rot)
 - Prefer cool temperatures
 - Repot when foliage dies
 - Propagate by corm division
 - Plant gets leggy under dim light; cut back to base
 - Propagate stem or tip cutting, air layering, or suckers
- 25.** African violet (*Saintapaulia ionantha*)
- Keep under medium light (avoid direct sunlight)
 - Keep soil moist, watering with tepid water (cold water can spot leaves)
 - Grows best in high temperatures
 - Fertilize frequently with low analysis fertilizer
 - Remove withered flowers
 - Propagate by leaf cutting, seed or by division
- 26.** Flamingo flower (*Anthurium scherzerianum*)
- Keep in partial light
 - Keep soil moist
 - Keep in warm place
- 27.** English ivy (*Hedera helix*)
- Display in bright, indirect light
 - Water well and keep humid
 - Prefers cool temperature
 - Prune to keep shape and control vine length
 - Propagate by stem cutting or division
 - Plant is suitable for training into topiary shapes
- 28.** Hyacinth (*Hyacinthus orientalis*)
- Display blooming plants in medium light
 - Water often during bloom
 - Keep temperature cool during blooming
 - Fertilize moderately
 - Remove and store bulb in cool place after the stem dies
 - Bulbs need to be precooled before flowering (place bulb in fridge for twelve weeks)
- 29.** Kalanchoe (*Kalanchoe blossfeldianer*)
- Place in southern window for high light
 - Drench and drain; keep dry between waterings
 - Prefers cool temperatures
- 30.** Dumbcane (*Dieffenbachia seguine*)
- Grows best in medium light (avoid direct light); can tolerate low light
 - Mist often and keep dry between waterings
 - Prefers high temperatures
 - Cut plant back to base when it becomes leggy
 - Propagate by stem cutting, suckers, or air layering
- 31.** Peperomia (*Peperomia obtusifolia*)
- Place in medium light; if variegated, the leaves might lose color in low light
 - Do not overwater

- Tolerates cool to warm temperatures
 - Prune as necessary to keep shape
- 32. Flame nettles (*Coleus* spp.)**
- Display in bright or full light for best color development
 - Keep soil moist and mist often
 - Grows best under cool temperatures
 - Pinching helps to shape plant and produce a bushy appearance
 - Propagate by cutting
- 33. Elephant's ears (*Caladium* spp.)**
- Keep out of direct full light
 - Keep soil moist
 - Grows best under high temperatures
- 34. Spider plant (*Chlorophytum comosum*)**
- Keep away from direct sunlight; prefers medium light
 - Keep temperatures at moderate level
 - Mist frequently
 - Fertilize moderately
 - Propagate by aerial runners or plantlets
 - Display as hanging basket
- 35. Croton (*Codiaeum variegatum*)**
- Prefers high light intensity (south window) for full color development
 - Keep temperature moderate
 - Leaves drop under drought stress of improper temperature (drafts)
 - Pinching can be used to create a bushy plant instead of a tall, single-stemmed plant
 - Propagate by air layering, or cuttings
- 36. Christmas cactus (*Schlumbergera bridgesii*)**
- Keep in south window for high light intensity
 - Keep soil dry between waterings and maintain high humidity
 - Keep temperatures moderate
 - When plant blooms, do not rotate the plant (flowers will drop)
 - Propagate by stem cuttings or seed

Plants that require low light should be placed at least five feet away from the window. Placed closer to the source of light, such plants can suffer severe foliage burn. They may be placed in room corners, hallways, and on shelves. To provide moderate light to plants, they should be placed five to eight feet from the window. Plants that require moderate to bright light should be placed three to five feet near the east and west windows. To receive bright light, plants should be kept two to three feet near the south-facing windows.

SUMMARY

Many plants can be grown indoors, provided the conditions for plant growth are adequately provided. Plants can be grown indoors to enhance the appearances of rooms. They can be strategically positioned to perform other functions such as dividing a room, directing traffic, and hiding unsightly areas. Indoor plant displays can be greatly enhanced by using ornate containers and placing them under a spotlight, for example. It is important that plants be brought indoors from the nursery in good condition. In winter and under severe weather conditions, plants need protection during transport from the nursery to the home. Various parts of the room in a house receive different amounts of light. As such, plants should be located carefully so that they receive the appropriate

amount and quality of light. If supplemental lighting is required, artificial light can be provided by using a variety of light source types, such as incandescent light, florescent light, or mercury vapor light. Florescent light sources are most efficient and recommended for home use. Incandescent light generates too much heat in the process of providing light. A room temperature of between 18 and 24°C (64.4 and 75.2°F) is adequate for most plants.

Many houseplants die as a result of excessive watering. The containers and media used should permit free drainage. Plants should be watered only when they need it. They may be watered from below by placing the pot in water or from above by using a watering can. As much as possible, water should not be left on the leaves, because this condition invites disease organisms. Since nurseries frequently use soilless media, plants need to be fertilized at periodic intervals to ensure good growth; either solid or liquid fertilizer preparations may be used. Potted plants outgrow their containers with time and need to be repotted into larger containers. As plants grow larger, some may require artificial support to stand erect. With good care and management, indoor plants seldom become diseased.

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Common houseplants

<http://www.urbanext.uiuc.edu/houseplants/>

Common houseplants

http://www.urbanext.uiuc.edu/houseplants/types_common.html

Examples of poisonous houseplants

<http://www.blankees.com/house/plants/poisonous.htm>

Houseplants problems

<http://www.ces.purdue.edu/extmedia/BP/BP-55.html>

PRACTICAL EXPERIENCE

Purpose: To study the effect of varying the levels of plant environmental growth factors on the growth of plants.

Materials and methods: Raise tomato seedlings and transplant individual plants into 6-inch (15.2-centimeter) pots (or smaller). Select twelve pots with plants of equal size and group into sets of three pots. Place the pots in an area in the greenhouse where they will be equally exposed to the environmental conditions. Apply four levels of a growth factor (fertilizer, moisture, light, and temperature) to the twelve pots, each set of three pots receiving only one of the levels. One of the levels should be “zero level”—that is, it should have only the normal conditions of the environment (e.g., no fertilizer at room temperature). This is called the control. Suggested levels are 0, 1x, 2x, and 3x (where x is a unit of the factor being applied). Your instructor will guide you to make the right choices.

Measure (nondestructively) plant characteristics of interest (e.g., height) at weekly intervals. Your instructor will assist you in applying appropriate statistical procedures to summarize the data and plot them graphically. Interpret your results.

OUTCOMES ASSESSMENT

1. Compare and contrast the environmental conditions required for growing plants outdoors and indoors, pointing out how they are managed for optimum plant growth.
2. Discuss, giving examples, how plants are used in the home.
3. Discuss the basis for locating plants in the home on the basis of light requirements.
4. Explain why plants often exhibit some degree of abnormal growth or changes in plant characteristics shortly after being brought home from the commercial greenhouse.
5. Discuss how moisture may be applied safely and effectively to potted plants.
6. Discuss how the materials used in making containers feature in the management of potted plants.
7. Give three major signs that a potted plant needs repotting.
8. Discuss the role of plant growth cycle and seasons in the water and nutrient management of houseplants.
9. Tap water may be injurious to some potted plants. Explain.
10. Discuss the properties of a desirable potting mix.