



## Using Houseplants To Clean Indoor Air

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In offices, homes, and other indoor areas, poor air quality can both cause health problems and make existing health problems worse. The U.S. Environmental Protection Agency currently ranks indoor air pollution as one of the top five threats to public health.

Indoor air pollution results from the release of chemical vapors and the suspension in the air of particulates such as dust and microorganisms. In response to increasing energy costs and the need to conserve energy resources, buildings and homes have been designed to be more energy efficient. Thus, many offices and new homes have tighter construction, sealing the building from the outside air. This makes it easier for indoor air pollutants to accumulate to dangerous levels. With people spending up to 70–90 percent of their time indoors, long-term exposure to indoor air pollution can cause various health problems.

Air pollution can build up in any confined space, but gases from synthetic materials used these days to construct or furnish offices and homes can, among other factors, result in “sick building syndrome.” While some people exposed to sick building syndrome will be unaffected, others who are hypersensitive to the pollutants can develop serious symptoms including eye, nose, and throat irritations, allergies, asthma, blurred vision, dizziness, fatigue, headache, skin irritation, nervous system disorders, and upper respiratory and sinus congestion.

### Sources of emissions of air pollutants

The major sources of indoor air pollutants are combustion byproducts, building materials, household products and chemicals, and bioeffluents. Combustion byproducts include carbon monoxide, nitrogen and sulfur dioxides, formaldehyde, and tobacco smoke. Combustion byproducts are produced by gas ranges, cook tops, water heaters, clothes dryers, smokers, and internal combustion engines turned on in enclosed spaces.

Sulfur dioxide is especially a problem on the island of Hawai'i due to emissions from its active volcanoes, and this “vog” can affect the other Hawaiian islands when southerly (“kona”) winds spread it up the island chain. Sulfur dioxide combines with atmospheric moisture to create sulfuric acid, which can severely burn the sinuses.

In construction, synthetic materials have replaced many natural building materials and are a source of harmful and hazardous gases. Formaldehyde, used in manufacturing many of these materials, is often a source of indoor air pollution. Pressed-wood products, carpets, and surface finishes that are oil-based, solvent-based, or alkyd-based are common building pollution sources.

Household products and chemicals that cause indoor air pollution include furniture waxes, paint strippers, adhesives, cleaning products, disinfectants, degreasers, and cosmetics. Some of these products release chemicals into the air during use, whereas others emit chemicals as they age, dry, or cure; this is known as out-gassing.

Bioeffluents are emitted by people and household pets through normal metabolic processes; these include substances such as carbon dioxide, carbon monoxide, methane, alcohols, acetone, phenols, volatile fatty acids, ammonia, hydrogen sulphide, and nitrogen oxides.

### Ways to improve indoor air quality

There are various ways to reduce indoor air pollution and improve air quality. Increasing ventilation and air exchange with the outside will help prevent the accumulation or reduce the amount of air pollutants indoors. In the case of sulfur dioxide emitted by volcanoes, it is advisable to close up the house if the vog episode is particularly bad. Exhaust fans can be installed in the kitchen and bathrooms, and air filters such as high-efficiency particulate air (HEPA) filters, which have a carbon filter component, can be used. Combustion appliances should



**Greenery can freshen the air and the ambience of an office workspace.**

be vented directly to the outside and regularly inspected, cleaned, and maintained. A byproduct of propane gas combustion is carbon monoxide. The house should be well ventilated when cooking or heating with propane.

Use only wood products that are formaldehyde-free or have low formaldehyde emissions. Seal the surfaces of wood products with surface finishes that are water-based. Select low-emission building products and carpets. Avoid household products that have hazardous vapors, and do not store hazardous products in the home. Product lines marketed as “eco-friendly” can be found at natural food stores and are becoming more readily available at mainstream supermarkets. Air out carpeting and other building materials before they are installed.

### **How houseplants help clean indoor air**

While developing technologies that allow humans to live in closed environments such as the International Space Station, NASA discovered that plants help reduce volatile organic chemicals/compounds (VOCs) and can be an efficient way to filter the air in living compartments. The Plants for Clean Air Council and Wolverton

Environmental Services have tested different houseplants for their ability to remove various toxic gases such as formaldehyde, xylene/toluene, and ammonia.

Plants absorb volatile organic compounds from the air into their leaves and then translocate them to their root zone, where microbes break them down. Microorganisms in the soil can use trace amounts of pollutants as a food source. Some organic chemicals absorbed by plants from the air are destroyed by the plant’s own biological processes. The plant’s roots take up aqueous solutions in the rooting media. Given that air also reaches plant roots, uptake by root tissues is another means by which air can be purified.

Plants add aesthetic and biological comfort to interior spaces. When plants are added to rooms, relative humidity can increase and particulate matter (dust) accumulation can decrease. Increasing relative humidity has a relaxing effect on people, and removing dust aids by reducing potentially allergy-inducing particles. Reducing particulate matter in a room may also be beneficial to computers and other electronic equipment by limiting the amount of dust collecting on circuit boards and clogging

**Table 1. Sources of some emissions that cause indoor air pollution.**

Source	Emission					
	Formaldehyde	Xylene/toluene	Benzene	Ammonia	Alcohols	Acetone
Adhesives	•	•	•		•	
Bioeffluents <sup>1</sup>		•		•	•	•
Carpeting					•	
Caulking compounds	•	•	•		•	
Ceiling tiles	•	•	•		•	
Cleaning products				•		
Cosmetics					•	•
Draperies	•					
Electrophotographic printers		•	•	•		
Fabrics	•					
Facial tissue	•					
Floor coverings	•	•	•		•	
Grocery bags	•					
Nail polish remover						•
Office correction fluid						•
Paints	•	•	•		•	
Paper towels	•					
Particleboard or chipboard	•	•	•		•	
Photocopiers		•	•	•		
Pre-printed paper forms						•
Stains and varnishes	•	•	•		•	
Upholstery	•					
Wall coverings		•	•		•	

<sup>1</sup>Substances emitted by people through normal biological processes such as respiration.

Source: B.C. Wolverton, PhD; How To Grow Fresh Air; Penguin, 1997; used with permission.

air vents.

During photosynthesis, carbon dioxide is taken in through plant foliage, and oxygen is produced and released by the plant as a byproduct. At night or when no photosynthesis is taking place, plants, like people, respire and give off carbon dioxide.

Volatile phytochemicals released by plant leaves appear to be important in controlling airborne microbes and mold spores in surrounding air.

Plants release water vapor via transpiration through the leaves and into the air, raising humidity. High transpiration rates create convection currents that cause toxin-laden air to be pulled down into the soil around the roots, where microbes in the soil break down the gases into a source of food and energy. Air also moves into and out of leaf stomata (pore-like openings). It should be noted, however, that higher humidity can lead to mold problems.

### Selecting houseplants

Common houseplants that have been found to be effective in cleaning indoor air are listed in the table on pages 4–5. Selection of houseplants to mitigate air pollution in

offices and homes depends not only on their ability to clean the air but also on their growth habit, the ease of growing and maintaining them, their light requirement, and, of course, your personal taste.

In an office or home, plants can have a profound influence on peoples' psychological well-being and serenity. It has been shown that plants in living and work spaces have a measurable beneficial effect on people. Benefits that have been documented where plants are added to the workplace include improved employee morale, increased productivity, and reduced absenteeism. In addition to plants adding beauty to a room and making it an inviting place to live or work, research has found that when people are near or tending plants, they feel relaxed and calm. Health and discomfort symptoms were found to be lower when indoor plants were present. These positive factors also need to be considered in the selection of appropriate houseplants.

Not all houseplants have been tested for their ability to clean indoor air. Of those tested, not all have proven equally effective. It cannot be assumed that all harmful pollutants can be removed by houseplants. While

Plant name	Description	Chemical vapor removal <sup>1</sup>	Light requirement	Remarks
Areca palm (butterfly palm), <i>Dypsis lutescens</i>	Clusters of erect, slender, cane-like stalks with feathery yellow-green fronds.	8	Sun to semi-sun	Releases an abundant amount of moisture into the air. Fast growing.
Bamboo palm, <i>Chamadorea elegans</i> or <i>C. erumpens</i>	Clusters of small slender canes. Graceful fans with rich green color.	9	Semi-sun	Releases an abundant amount of moisture into the air. Easy to care for.
Boston fern, <i>Nephrolepis exaltata</i>	Stiff fronds arch outwards, drooping downward as they age.	9	Semi-sun	Releases an abundant amount of moisture into the air. Ideal for hanging baskets. Mist and water frequently to reduce leaf drop.
Corn plant, <i>Dracaena fragrans</i> 'Massangeana'	Shiny medium green leaves with a bold yellow-white stripe down the center. Develops a solid woody stem. Leaves concentrate at the top of each stem.	8	Semi-shade	Survives in dimly lit areas. Occasionally will send up a small spray of fragrant white flowers.
Dendrobium orchid	Has beautiful exotic blooms, usually in clusters or in a row along canes.	7	Semi-sun	Flowers are long lasting.
<i>Dracaena deremensis</i> 'Janet Craig'	Erect stems with a rosette of broad, smooth, glossy, dark-green leaves 12 inches long and 2 inches wide.	8	Semi-shade	Grows quickly. Tolerates dimly lit areas, but growth will be slow.
<i>Dracaena deremensis</i> 'Warneckeii'	Leaves, 2 feet long and 2 inches wide, are green with white and gray-green stripes.	6	Semi-shade	Grows slowly. Tolerates low light and dry air. Retains its variegation in low light.
Dragon tree, <i>Dracaena marginata</i>	Smooth, gray, erect canes. Leaves, 2 feet long and 1/2 inch wide, are deep, glossy green with red edges along the margins. Leaves cluster at the end of each cane.	6	Semi-sun to semi-shade	Tolerates relatively low light and dry air.
Dumbcane, <i>Dieffenbachia</i> varieties*	Wide, blotched green and white (cream) leaves. Unbranched stems arch downward.	7	Semi-sun to semi-shade	Fast growth.
Dwarf date palm, <i>Phoenix roebelinii</i>	Stately main trunk with graceful, green fans that droop elegantly. Fronds reach 3 feet and grow horizontally.	9	Semi-sun	Very slow grower. Adapts well to low light levels.
English ivy, <i>Hedera helix</i> *	Vigorous climber which sends out aerial roots that attach to any surface. Dark green leaves have 3 to 5 lobes.	9	Semi-sun to semi-shade	Easy to grow. Ideal for hanging baskets. Generally does not do well in high temperatures.
<i>Ficus bennendijkii</i> 'Alii'	Slender dark green leaves.	7	Full sun and semi-sun	Easy to grow. May have some leaf drop until it adjusts to its new location.

Florist's mum, <i>Chrysanthemum morifolium</i>	Produces a brilliant display of colorful flowers.	9	Full sun and semi-sun.	Avoid midday sun as the heat may age the blossoms prematurely.
Gerbera daisy, <i>Gerbera jamesonii</i>	Sturdy stems that have colorful flowers. Leathery leaves.	9	Full sun and semi-sun	Releases abundant moisture into the air. Avoid midday sun as the heat may age the blossoms prematurely.
Golden pothos, <i>Epipremnum aureum</i>	Vine with green heart-shaped leaves with gold or cream colors.	5	Semi-shade to shade	One of the easiest houseplants to grow. Fast growth. Can be grown as a hanging basket or trained to climb.
Kimberley queen fern, <i>Nephrolepis obliterata</i>	Fern with graceful, drooping fronds and lush green foliage.	9	Semi-sun to semi-shade	Releases an abundant amount of moisture into the air. Mist and water regularly to reduce leaf drop.
King of hearts, <i>Homalomena wallisii</i>	Dark, olive-green, oval-shaped leaves with areas of silver or cream. Leaves 8 inches long.	7	Semi-shade to shade	Slow growing. Can be difficult to maintain.
Lady palm, <i>Rhapis excelsa</i> or <i>R. humilis</i>	Large palm with fans 6 to 12 inches wide with 4 to 10 thick shiny leaves. Brown hairy main trunk with thin arching stems.	7	Semi-sun	Grows slowly. One of the easiest houseplants to care for.
Lily turf, <i>Liriope muscari</i>	Grassy arching evergreen leaves reaching 6 to 18 inches long. May be dark green or variegated.	7	Semi-sun to semi-shade	Produces small spikes of white or lavender flowers.
Peace lily (White flag), <i>Spathiphyllum</i> varieties	Sends up stiff erect stalks that produce beautiful white spathes. Dark green leaves stand erect in the juvenile stage, but start to bend as they mature.	8	Semi-shade to shade	Releases an abundant amount of moisture into the air. Tolerant of low light. Will bloom indoors.
<i>Philodendron erubescens</i> * 'Red Emerald'	Vining habit. Burgundy-red leaves are long and narrow with yellow veins.	6	Semi-shade to shade.	Easy to grow. Needs to be staked or given support for climbing.
Rubber plant, <i>Ficus elastica</i> *	Thick, leather-like, glossy, dark-green leaves that contain a rubber-like latex.	9	Semi-sun to semi-shade.	Easy to grow. Tolerates low light.
Schefflera (umbrella tree), <i>Brassaia actinophylla</i> *	Has long stems with 7 to 16 deep green leaves, each up to 12 inches long.	8	Semi-shade.	Easy to grow.
Spider plant (airplane plant), <i>Chlorophytum comosum</i>	Sends up slender, arching shoots with leaves that may be green or green with a broad center stripe of yellow or cream. Leaves 6–12 inches long.	6	Semi-sun to shade.	Ideal for hanging baskets. Has small white flowers at the end of aerial runners, which are followed by airborne plantlets.
Weeping fig, <i>Ficus benjamina</i> *	Treelike growth habit. Graceful drooping branches. Small, dark green, pointed, glossy leaves.	8	Full sun to semi-sun.	Leaf drop is common until it adjusts to its new environment.

<sup>1</sup>Rating 1 to 10, with 10 being excellent. \*May be hazardous or toxic if eaten or comes in contact with eyes or skin; keep plants away from children.



**Extensive use of plants in an indoor setting can create the feeling of outdoors; this indoor greenhouse-type structure is in a botanical garden on Awaaji Island near Osaka, Japan.**

houseplants are not a “total solution” to improving indoor air quality, they should not be overlooked as an aid in creating interior spaces conducive to the health of those who occupy them.

### **Acknowledgement**

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**Large interiorscape plantings combined with pools or fountains greatly enhance the ambiance of an office building or hotel lobby while improving the air quality of the interior environment; this is an atrium at the Embassy Suites, Orlando, Florida**

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