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AIR-FILTERING PLANTS FOR INDOOR USE

The practice of growing green foliage in homes has a long history. Growing up in the heat of Texas, and not being endowed with a green thumb, I used easy-to-grow houseplants to introduce natural beauty into the home and to improve the quality of indoor air. Air quality is improved as plants convert light to oxygen through photosynthesis--reducing carbon dioxide levels and releasing oxygen into the environment. There has also been anecdotal evidence about the ability of plants to clean the air in enclosed spaces. More recently, several research studies have documented the use of plants to absorb various toxic chemicals leached into the air in our homes by common building materials, furnishings and cleaning agents.

Volatile organic compounds (VOCs) are vapors or gasses released by common articles found in homes and office buildings, such as carpets, paints, plywood, particle board, varnishes, inks, plastics, adhesives and some cleaning agents and products. Unfortunately, newer homes and buildings often contain even higher levels of VOCs. Probably, the best known VOC is formaldehyde--ubiquitous in its use and prevalence in homes and buildings. Other VOCs include benzene, xylene, toluene, and trichlorethylene (TCE). TCE is widely used in dry cleaning, while benzene is frequently used as a solvent. As these compounds are released into the air, the quality of the air deteriorates. As we breathe in VOCs in our homes and work environments, there is increasing evidence that our health is being compromised.

Indoor air pollution has worsened and led scientists to suggest that air inside our homes is two to five times more polluted than outdoor air. Science and technology have allowed us to seal off indoor environments to promote energy efficiency. However, this has decreased air exchange and increased the concentration of VOCs in the air. There are current recommendations to open windows and doors more often to allow improved air circulation and exchange. The use of machines to strip or filter out VOCs in indoor air has become a big business. Indoor air pollution is linked to increased rates of respiratory illnesses including allergies and asthma. Headaches, sore throats, and irritated eyes have been so widely reported that the terms "multiple chemical sensitivity" or "sick building syndrome" have become part of our vernacular.

The physical, emotional, and medical symptoms associated with VOCs released in our working and living environments are raising concerns. "The concern is widespread; a 2002 report from the World Health Organization estimated that undesirable indoor volatiles represent a serious health problem that is responsible for 1.6 million deaths per year and 2.7 per cent of the global burden of disease."[1] The sensitive mucous membranes in the throat and nose are irritated by VOCs such as formaldehyde and benzene. Formaldehyde and benzene also inflame and irritate

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[1] American Society for Horticultural Science (June 24, 2011). Study of phytoremediation benefits of 86 indoor plants published; Japanese royal fern tops list for formaldehyde removal effectiveness. *ScienceDaily*. Retrieved February 2, 2013, from http://www.sciencedaily.com- /releases/ 2011/06/110623174134.htm.

the eyes, which is associated with frequently reported headaches. It is thought leaf structures like the tiny openings in leaves or stomata, which open during the day, absorb VOCs. Roots of the plants have been placed by themselves and can absorb gasses. There may be some benefit from the microorganisms living in the roots and soils as well.

"Phytoremediation--the use of green plants to remove pollutants or render them harmless-- is seen as a potentially viable and environmentally significant means of improving the indoor air quality in homes and offices."[2] Dr. B. C. Wolverton, a former senior researcher with NASA, published several works on the positive effects of plants on air quality in buildings, homes, and space stations. These findings and others led to a two-year study by the Associated Landscape Contractors of America (ALCA) and NASA, which finds common varieties of houseplants can absorb some of the harmful vapors which pollute indoor air. Some plants absorbed more vapors in the day, while others had higher nighttime absorption rates. More research and study is needed to determine the effectiveness and means of plants' ability to filter the air.

Wikipedia, a free internet-based resource, lists plants used in the NASA Clean Air Study, and plants studied by Dr. Wolverton to remove pollutants from indoor air. Wikipedia also warns of toxicity to children, cats and dogs if plants are chewed or eaten. For example, while the golden pothos or Devil's ivy (Scindapsus aures or Epipremnum aureum) is very effective in filtering VOCs, it is poisonous when chewed or swallowed by children or pets. Likewise, the Mother-in-law's tongue (Sansevieria trifasciata 'Laurentii'), which is listed as effective in many studies, is toxic to cats and dogs when chewed or eaten.

Over 100 plants have been studied, and there are some differences in opinions on the 'best' plants to filter air in the home or office. However, certain plants are most often considered to be the best air-filtering plants for indoor use. These plants include ferns, palms, philodendron, dracaena, dumb cane, English ivy, the peace lily and Mother's-in-Law-Tongue. Flowering plants that improve air quality for the indoor environment include the Gerbera Daisy (Gerbera Jamesonii) and the pot mum (Chrysanthemum morifolium). The majority of the plants used in these and other studies have been easy to grow plants that tolerate low light and originated in tropical and subtropical regions. Their ability to use photosyntheses in low light conditions makes them ideal choices for indoor areas.

Ferns may be the best plants for removing VOCs from the environment. In 2011, a study was published in the journal of the American Society for Horticultural Science citing the superiority of ferns in removing formaldehyde from the atmosphere. Plants and plant parts were placed in airtight containers and exposed to gaseous formaldehyde. Eighty-six indoor plants were tested on their ability to remove this toxic gas from the air in the containers. Ferns were superior in their ability to remove formaldehyde from the containers, clearing nearly 80 percent of the toxic

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[2] *Id.*

gas within hours. Toxic gasses in containers without plants or plant parts declined only seven percent. This study also concluded the Japanese royal fern (Osmunda japonica) was superior to other ferns and plants in the removal of gaseous formaldehyde.

The Boston fern (Nephrolepis exalta "Bostoniensis"), Kimberly queen fern (Nephrolepis obliterata), and Spider fern (Pteris multiffida), have all been studied for environmental use. Ferns are more difficult to grow indoors largely because of the lack of humidity in indoor spaces and a need for individualized care. My own experience with these beautiful plants has been replete with brown edges and tips, spider mites and many fern deaths. In California, I have had success with spider ferns, which seem easy to grow-- tolerating lower humidity levels in the winter and lapses of watering. I have placed them near windows, and as much as fifteen feet from windows, and they appear indifferent. The Boston fern still graces my home from time to time, but prefers the company of other plants on my shady back porch during spring and fall.

Philodendron plants studied include the Heartleaf philodendron (Philodendron oxycardium, syn. Philodendron cordatum), and the Elephant ear philodendron (Philodendron domesticum). Philodendrons can be toxic to cats. The dracaena plants used in the NASA and Wolverton studies included the Red-edged or (Dracaena marginata), the Cornstalk or Corn Plant (Dracaena fragans Massangeana), and the Janet Craig (Dracaena deremensis Janet Craig). Both the philodendron and dracaena plants are easy to grow, tolerating lower light and humidity levels and forgiving neglect almost without fail. Water when the soil is dry to the touch, placing your finger about one inch into the soil. I find watering once a week from spring to fall, and watering every two weeks during the winter months is sufficient and easy to remember. These plants can be brought indoors or planted indoors at all times of the year.

My favorite indoor plants are the Areca palms (Chrysalidocarpus lutescens) and the Peace lily (Spathiphyllum 'Mauna Loa'). The Areca palms are graceful additions to any indoor space. I place them next to a window-- southern exposures provide an abundance of bright light without the afternoon heat of a western facing window. The Peace lily is one of the most effective filtering plants--having the ability to reduce levels of formaldehyde, TCE, benzene, xylene, toluene and ammonia. These plants can be toxic to cats but, I have never had a problem with my cats or dogs. They are beautiful plants with elegant white flowers and shiny, dark green leaves. They are adaptable to differing light conditions and don't require individualized care. I have used them in home and office environments very successfully, where they always greet me with a cheery reminder of outdoors. All of my houseplants are bought from commercial nurseries and grown in potting soils. They generally don't require the addition of fertilizers. Because I don't use fertilizer, the plants have no problems with root burn, and the soil does not need flushing. However, for flowering plants like the Peace lily, I use a liquid organic fertilizer or a diluted complete liquid food such as 6-10-4 in the growth cycles of spring and summer.

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While California rain comes in the winter months, humidity can drop to ten percent in indoor spaces during the winter. Most houseplants thrive with humidity around 50 percent. Humidifiers can be placed among plants or plants can be misted with water or grouped together to increase humidity. Saucers or pans of water can also be placed near plants to help increase humidity. A plant can be set on top of a saucer containing pebbles or pot shards and water. The pebbles prevent the bottom of the plant from touching the water, while the water provides a good source of humidity for the plant. Plants can be washed in tepid water in sinks or showers for cleaning of foliage and to rinse the soil. Wiping the plant leaves with damp or moist soft towels keeps them clean from dust and insects. It is important to keep houseplants away from heater or air conditioning vents and drafts. The plants listed can tolerate temperatures ranging from 60 to 80 degrees Fahrenheit.

There is an esthetic appeal to foliage and flowers in our environment. They contribute to the beauty of our indoor lives, and connect us to nature in very real ways. Neuroscience informs us that natural elements--even merely looking at photos of nature--releases calming chemicals into our bodies. Plants make us happier and more calm. They release oxygen into our air which decreases carbon dioxide levels. In addition there is growing evidence of plants' ability to clean the air we breathe by reducing toxic gasses--improving our quality of life and life on the planet. It is ironic with our advancing science and technology, it is nature to which we turn back in order to solve the problems we have helped to create. As I end this paper, I open the nearby window, and move closer to my Peace lily.

Bibliography

Asakawa, Bruce and Sharon. California Gardener's Guide. Cool Spring's Press, Nashville, Tennessee, 2000.

Ellis, Barbara and Bradley, Fern Marshall. The Organic Gardener's Handbook of Natural insect and Disease Control. Rodale Press, Emmaus, Pennsylvania, 1996.

8 Best Plants to Grow Indoors, http://www.care2.com/greenliving/8-best-plants-to-grow-indoors.html?page=1. Retrieved January 10, 2013.

How Your Home Affects Your Health, http://www.care2.com/greenliving/how-your-home-affects-your-health.html?page=1. Retrieved February 2, 2013.

List of air-filtering plants, http://en.wikipedia.org/wiki/List of air-filtering plants. Retrieved January 10, 2013. Retrieved January 10, 2013.

NASA Study House Plants Clean Air, http://www.zone10.com/nasa study house plants clean air.html. Retrieved January 10, 2013.

Society for Horticultural Science (June 24, 2011). Study of phytoremediation benefits of 86 indoor plants published; Japanese royal fern tops list for formaldehyde removal effectiveness. *ScienceDaily*. Retrieved February 2, 2013, from http://www.sciencedaily.com- /releases/ 2011/06/110623174134 html.