

**Title:**

The Level of Volatile Organic Compounds Exposure in New Buildings: Can Adding Indoor Potted Plants Reduce Exposure?

**Kelly Vazquez**

Lydia Adams

*School of Nursing, University of Alabama in Huntsville, Huntsville, AL, USA*

---

**Session Title:**

Rising Stars of Nursing Invited Posters - Group 2

**Slot (superslotted):**

RSG STR 2: Friday, September 26, 2014: 10:00 AM-10:30 AM

**Slot (superslotted):**

RSG STR 2: Friday, September 26, 2014: 11:45 AM-1:00 PM

**Slot (superslotted):**

RSG STR 2: Friday, September 26, 2014: 3:00 PM-3:30 PM

---

**Keywords:**

Indoor plants, Sick building syndrome and Volatile organic compounds

**References:**

References Agency for Toxic Substances and Disease Registry [ATSDR]. (2011, March 3). U.S. Department of Health and Human Services. Retrieved from <http://www.atsdr.cdc.gov/phs/phs.asp?id=3&tid=1> Arts, J.E., Mojet, J., Gemert, L.J., Emmen, H.H., Lammers, J.H., Marquart, J., Woutersen, R.A., & Feron, V.J. (2002) An analysis of human response to the irritancy of acetone vapors. *Critical Reviews in Toxicology*, 32(1), 43-66. Aydogan, A., & Montoya, L. D. (2011). Formaldehyde removal by common indoor plant species and various growing media. *Atmospheric Environment*, 45, 2675-2682. doi: 10.1016/j.atmosenv.2011.02.062 Centers for Disease Control and Prevention.[CDC] (2010, November 18). Acetone. Retrieved from <http://www.cdc.gov/niosh/npg/npgd0004.html> Cumpton, K.L., Vogel, S.N., Leiken, J.B., & Erickson, T.B. (2003). Acute airway compromise after brief exposure to a dieffenbachia plant. *The Journal of Emergency Medicine*, 25 (4), 391-397. Environmental Protection Agency [EPA] (2012a, July 9). An Introduction to Indoor Air Quality Retrieved from <http://www.epa.gov/iaq/voc.html> Environmental Protection Agency. (2012b, June 20). An introduction to indoor air quality. Retrieved from <http://www.epa.gov/iaq/formaldehyde.html> Environmental Protection Agency. (2011, March 10). Indoor air. Retrieved from <http://cfpub.epa.gov/eroe/index.cfm?fuseaction=list.listBySubTopic&ch=46&s=343> Environmental Protection Agency. (2013a, October 18). Formaldehyde. Retrieved from <http://www.epa.gov/ttnatw01/hlthef/formalde.html> Environmental Protection Agency. (2013c, September 9). Glossary of Climate Change Terms. Retrieved from <http://www.epa.gov/climatechange/glossary.html> Environmental Protection Agency. (2013b, October 18). Styrene. Retrieved from <http://www.epa.gov/ttn/atw/hlthef/styrene.html> Kagi, N., Fujii S., Tamura H., & Namiki N. (2009). Secondary VOC emissions from flooring material surfaces exposed to ozone or UV radiation. *Building and Environment*, 44, 1199-1205. Kim, K. J., Kil, M. J., Song, J. S., Yoo, E. H., Son, K., & Kays, S. J. (2008). Efficiency of volatile formaldehyde removal by indoor plants: Contribution of aerial plant parts versus the root zone. *Journal of American Society of Horticulture Science*, 133(4), 521-526. Kumagai, S., Matsunaga, I., & Tabuchi, T. (1998). Effects of variation in exposure to airborne acetone and difference in work load on acetone concentrations in blood, urine, and exhaled air. *American Industrial Hygiene Association Journal*, 59, 242-251. Occupational and Safety Administration. (no date listed). Acetone. Retrieved from [https://www.osha.gov/dts/chemicalsampling/data/CH\\_216600.html](https://www.osha.gov/dts/chemicalsampling/data/CH_216600.html) Redlich, C.A., Sparer, J., & Cullen, M.R. (1997). Sick-building syndrome. *The Lancet*, 349, 1013-1016. Roder-Stonlinski, C., Fischader, G., Oostingh, G. J., Feltens, R., Kohse, F., Bergen, M., Morbt, N., & Eder, K. (2008). Styrene induces an inflammatory response in human lung epithelial cells via oxidative stress and nf-kb activation. *Toxicology and Applied Pharmacology*, 231, 241-247. doi: 10.1016/j.taap.2008.04.010

Sawada, A. and Oyabu, T. (2008). Purification characteristics of pothos for airborne chemicals in growing conditions and its evaluation. *Atmospheric Environment*, 42, 594-602. Sclanders, L.C. (2010). The power of environmental adaptation: Florence Nightingale's original theory for nursing practice. *Journal of Holistic Nursing*, 28 (1), 81-88. doi: 10.1177/0898010109360257 Xu, Z., Wang, L., & Hou, H. (2011). Formaldehyde removal by potted plant-soil systems. *Journal of Hazardous Materials*, 192, 314-318. doi: 10.1016/j.hazmat.2011.05.020 Wolverton, B. C., & Wolverton, J. D. (1996). Interior plants: their influence on airborne microbes inside energy-efficient buildings. *Journal of the Mississippi Academy of Sciences*, 41(2), 99-105. Wongvijitsuk, S., Navasumrit, P., Vattanasit, U., Parnlob, V., & Ruchirawat, M. (2011). Low level occupational exposure to styrene: Its effects on dna damage and dna repair. *International Journal of Hygiene and Environmental Health*, 214, 127-137. doi: 10.1016/j.ijheh.2010.09.007

**Learning Activity:**

<b>LEARNING OBJECTIVES</b>	<b>EXPANDED CONTENT OUTLINE</b>	<b>TIME ALLOTTED</b>	<b>FACULTY/SP EAKER</b>	<b>TEACHING/LEARNING METHOD</b>	<b>EVALUATION/FEEDBACK</b>
<b>Example</b> Critique selected definition of the term, "curriculum"	<b>Example</b> Definitions of "curriculum" Course of study Arrangements of instructional materials The subject matter that is taught Cultural "training" Planned engagement of learners	<b>Example</b> 20 minutes	<b>Example</b> Name, Credentials	<b>Example</b> Lecture PowerPoint presentation Participant feedback	<b>Example</b> Group discussion: What does cultural training mean to you?

<p>Determine certain harmful chemicals that can be emitted from materials used in the construction of newer buildings and the health effects that these chemicals can cause.</p>	<p>Harmful chemicals, known as volatile organic compounds or VOCs, including formaldehyde, acetone, styrene, 2-methylbutane, and toluene are commonly used in the manufacture of new building materials. These chemicals can lead to health issues including headache, nausea, dizziness, eye irritation, respiratory irritation, drowsiness, fatigue, and general malaise. Exposure</p>	<p>10 minutes</p>	<p>Kelly Vazquez, RN, BSN</p>	<p>Poster presentation</p>	<p>What health effects can exposure to certain VOCs cause?</p>
--	--	-------------------	-------------------------------	----------------------------	--

	to some of these chemicals can even lead to more serious conditions such as cancer.				
Identify a cost effective and efficient way of reducing indoor air pollutants in office buildings.	The addition of indoor plants has been shown to greatly decrease the amount of VOCs in indoor air. This new knowledge can be used as a preventative measure by health care providers when teaching about environmental health risks and hazards and how to keep these VOCs at	10 minutes	Kelly Vazquez, RN, BSN	Poster presentation	What is a cost effective and efficient method of reducing VOCs?

	a minimal risk.				
--	-----------------	--	--	--	--

**Abstract Text:**

**Background:** According to Florence Nightingale, “the connection between health and the dwelling of the population is one of the most important that exists.” In the United States, people spend approximately 90% of their time indoors with a typical work week consisting of 40 to 50 hours, frequently exposing them to indoor air pollutants, some of which can be harmful to the human body. These indoor air pollutants, called volatile organic compounds (VOCs), have been found to be much higher in new buildings. Research shows that VOCs can cause acute and chronic health effects (e.g., headaches, genotoxicity, CNS depression, cancer, and congenital abnormalities) making discovering ways to reduce the amount of VOCs in the workplace critical. It is vital as nurses to educate patients on harmful chemicals and ways to find efficient, cost effective ways to reduce them. One way to accomplish this is by adding plants to dwelling spaces which has shown to greatly decrease the level of air pollutants. Formaldehyde, acetone, styrene, 2-methylbutane, and toluene are examples of some VOCs that have shown to cause serious health effects. This study sought to determine the health effects and levels of these VOCs and determined if their levels decreased after the addition of indoor plants.

**Methods:** Two offices were tested in a newer building and two offices were tested in an older building. The chemical levels were tested before plants were added and were retested after plants were added at four and six weeks.

**Results:** In the new building, formaldehyde increased by the fourth week, but decreased by the sixth week, while acetone decreased by the fourth week and increased by the sixth week. In the older building, acetone increased by the fourth week and decreased by the sixth week. Formaldehyde decreased by the fourth week and increased by the sixth week. No styrene was found in any office at any time. A reduction in 2-methylbutane levels was observed in two out of four ‘post-plant’ measurements and a reduction in toluene levels was observed in three out of four ‘post-plant’ measurements.

**Conclusion:** Employees may become exposed to VOCs in office buildings. As healthcare providers, nurses can educate people about what these harmful chemicals are and ways to reduce exposure. Nurses can also introduce efficient methods, such as adding plants, to decrease these chemicals in the places where people spend the most time.