

# WHY GREEN CLEAN

## INTRODUCTION

Approximately 50 million children in the United States spend as many as 10 hours a day inside of a school building, together with large numbers of teachers and staff.<sup>1</sup> Healthy school environments are essential to ensure the best setting for learning. When school environments are unhealthy, students and staff may be exposed to harmful pollutants and chemicals that can cause their health, attendance, and scholastic performance to suffer.

Among the factors that can affect the environmental quality of school indoor environments are school siting, building materials and operation, and maintenance practices including management of moisture and mold pests, lab and other chemicals, and cleaning products. One of the maintenance practices that should be considered by all schools is “green cleaning.”

While there is no standardized definition for green cleaning, health and environment experts recommend safe and environmentally friendly cleaning practices to provide effective cleaning processes that protect the environment and prevent toxic exposures of students and staff.<sup>2</sup>

# IN OUR SCHOOLS?

The benefits of green cleaning extend far beyond preventing toxic exposures among students and staff. Other benefits include:

- a reduction in cleaning and labor costs;
- effective cleaning results;
- increased student attendance, potentially resulting in additional state funding;
- reduction of the school's waste stream; and
- an extended life for the school building.<sup>3</sup>

This article documents—through both scientific evidence and anecdotal reports—the considerable benefits of introducing green cleaning practices in schools, with an emphasis on human health and cost savings.

## HEALTH AND GREEN CLEANING

When implementing green cleaning practices, the prevention of toxic exposures to students and staff is of the utmost importance. A student's health, classroom performance, and achievement can all be greatly affected by an unhealthy learning environment. For example, some chemicals in cleaning products when released into the air can trigger asthma attacks and adverse health symptoms—including respiratory irritation, sore throats, and

watery eyes—in staff and students. These symptoms are likely to be experienced to a greater degree by students, especially young students. Children are likely to be more susceptible to the harmful effects of many environmental contaminants because their exposures to chemicals in the environment are generally much greater than those of adults. Children eat, drink, and breathe far more relative to their body weight than adults, leading to the higher exposures.

Young children's behaviors can also result in much higher exposures to environmental contaminants than adults.<sup>4</sup> Numerous research studies have shown that young children can be exposed to various contaminants during normal exploration of their environment (especially hand-to-mouth behavior) and by touching floor surfaces and objects such as toys.<sup>5</sup> Explorative tendencies among children will result in higher ingestion rates of soil and dust because they spend a considerable amount of their time playing on floors.

Children's developing organ systems can also be much more susceptible to the effects of environmental contaminants. Children's respiratory, immune, nervous, reproductive, and skeletal systems continue to develop throughout childhood, and impacts that occur early in life can have impli-

cations well into adulthood.<sup>6</sup> In children, full lung development does not occur until approximately 18 years of age.<sup>7</sup> Accounting for differences in body weight, children have a larger lung surface area and breathe a greater amount of air than adults.<sup>8</sup> A child's breathing pattern also differs from an adult's. At rest, adults typically breathe through their nose, while children more commonly breathe thorough their mouths. For all of these reasons, environmental contaminants in air can affect children's airways differently than adults.<sup>9</sup>

Children's immune systems also continue to rapidly develop after birth.<sup>10</sup> Scientific research suggests exposure to environmental contaminants can cause alterations in a child's developing immune system, which may lead to the onset of allergies and sensitization of the respiratory system that is typical of asthma.<sup>11</sup> The period when children's airways and immune system are developing is a particularly sensitive time for the onset of asthma in children, as the onset and incidence of asthma attacks frequently result from an inappropriate immune response to environmental exposures.

Many cleaning products may contribute to elevated airborne concentrations of a variety of chemicals, and inhalation of these chemicals by children is often of greater concern because

their developing immune and respiratory systems are particularly sensitive to the effects of chemical pollutants.<sup>12</sup> Cleaning products that release volatile organic compounds (VOCs), which have been identified as asthma triggers, are likely to have a greater impact on children than adults.

Asthma is one of the most common chronic diseases in children,

accounting for more lost school days than any other health condition.<sup>13</sup> While the prevalence of asthma has been reported to be slightly less than 10 percent in American children as a whole, there are significant disparities in asthma prevalence across the American population.<sup>14</sup> For example, in 2009 the prevalence of asthma in African American children living below the poverty line was approximately 18 percent, or nearly twice the national average. In some communities of Puerto Rican descent, the prevalence of asthma has been reported in excess of 20 percent. Children in many of these same communities experience achievement gaps in standardized tests, and increased absenteeism due to health concerns only exacerbates this problem.

The respiratory health of custodial workers is also important when selecting cleaning products and practices, because they experience the highest exposures to cleaning products. A single custodial worker uses, on average, 194 pounds of chemicals each year,<sup>15</sup> many of which contain VOCs. A study published in the American Journal of Industrial Medicine found that janitorial workers and firefighters experience the highest rates of occupational asthma.<sup>16</sup> Workers compensation data from Washington State show that six of every 100 janitors annually have lost time due to chemical injuries, such as eye irritation or burns, skin irritation or burns, and the inhalation of chemical fumes.<sup>17</sup>

A child's heightened susceptibility to environmental contaminants from chemical exposure needs to be accounted for when a school makes decisions involving chemical purchases and usage. These considerations are

especially critical when evaluating a school's cleaning products and practices for students and custodial staff. Adopting a green cleaning approach will enable a school to provide a healthier learning environment that meets the unique developmental needs of its students, as well as improved working conditions for staff.

## GREEN CLEANING

School environments are healthier when they are kept clean. Routine and thorough cleaning is important to prevent pests, minimize irritants and allergens, and create healthier working environments for students and staff. While schools can choose from myriad cleaning products, selecting less hazardous cleaning products and implementing practices that pose the least amount of harm to human health and the environment is the best place to start to protect student and staff health. Additionally, less hazardous cleaning products improve indoor air quality and reduce water and ambient air pollution.

Green cleaning products should have one or more of the following attributes:

- low or no volatile organic compounds;
- neutral pH levels;
- no known carcinogens;
- biodegradable;
- energy and water saving benefits; and
- less packaging.<sup>18</sup>

There are a number of third party environmental certification programs that identify green cleaning products through labeling, such as Green Seal, Green Guard, EcoLogo, and the

The prevalence of asthma in African-American children living below the poverty line was approximately

**18 percent,**

or nearly twice the national average. In some communities of Puerto Rican descent, the prevalence of asthma has been reported in excess of

**20 percent.**

Children in many of these same communities experience achievement gaps in standardized tests, and increased absenteeism due to health concerns only exacerbates this problem.





United States Environmental Protection Agency (EPA) Office of Pollution Prevention and Toxics (OPPT) Design for the Environment (DfE) safer product labeling program. For the past 15 years, the EPA's DfE Program has applied the Agency's expertise in chemicals, toxicology, and environmental science to evaluate chemical formulations and allow use of the DfE label on products that perform well and contain safer ingredients. All labeled products must meet DfE's Standard for Safer Products and stringent component-class criteria.

The DfE scientific review team evaluates each ingredient for potential human health and environmental effects based on the best currently available scientific information, EPA predictive models, and expert judgment to ensure that candidate products contain only ingredients that are among the safest in their functional class. The DfE review process focuses on chemical exposures during use and end-of-life "hot spots" in the life cycle of chemical-based products, as well as other important factors like VOCs, packaging, and audits. The DfE standard includes an ingredient disclosure provision that will make the safer chemistry aspects of labeled products better known to the public. DfE has now labeled more than 2,700 safer products for a wide variety of consumer and industrial uses (view full listing at <http://www.epa.gov/dfe/pubs/projects/formulat/formpart.htm>).

Products containing cleaning agents that may pose a hazard to human health should be used judiciously and only when necessary. (*See Table 1.*)

In addition to the risks posed by certain chemicals contained in cleaning

products, the mechanical and abrasive methods used with many cleaners can carry their own set of risks. Studies have shown that the soils removed from schools janitorial equipment, such as vacuum cleaners and floor buffers, can be contaminated with a host of toxic agents including lead, pesticides, VOCs, and mold spores.<sup>19</sup> Purchasing janitorial equipment that will have a negative impact on human health and the environment should also be considered when preventing toxic exposures among students and staff.

## COST SAVINGS

When properly applied, green cleaning products and practices cost about the same as conventional cleaning methods, and many schools and school districts across the nation have reported cost savings when they implemented a green cleaning program. The Illinois Green Clean Schools Act of 2007 was written to include an exemption clause that would allow schools to opt out of the law if they determined green cleaning would increase their cleaning costs. By 2009, only four schools out of 900 school districts sent notices to the state that green cleaning was not economically feasible.<sup>20</sup>

Many certified green cleaning products are more highly concentrated than conventional cleaning products and come with specially engineered dilution control packaging to guarantee products are used at the appropriate concentration. Automated dilution of green cleaning products prevents waste caused by unmeasured pouring, resulting in cost savings. Two schools in Honolulu, Hawaii reduced their cost of restroom cleaning prod-

ucts from \$6-12 per gallon to less than \$1 per gallon by replacing a ready-to-use conventional product with highly concentrated Green Seal certified product that is typically diluted with 64 to 256 parts water.<sup>21</sup>

School districts can also save money by adopting one simple, yet highly effective, green cleaning practice—the installation of "walk-off" mats at all major entries.<sup>22</sup> Cleaning industry estimates suggest that 85 percent of the dirt found in schools is tracked in through entryways. Entrance mats that are properly sized and extended into the school (typically 15 feet) can trap up to 80 percent of dirt. Anecdotal evidence suggests that effective use of mats can generate savings as much as 30 to 40 percent per year. In a facility with an average cleaning cost of \$1.63 per square foot, the savings in dusting, vacuuming, mopping, waxing, and stripping floors could reach \$ 0.41 per square foot. Cost estimates indicate that when these savings are applied to a 100,000 square foot school building, the potential savings could be as high as \$41,000 a year.<sup>23</sup>

While many of the costs savings associated with green cleaning are readily apparent, there are several indirect benefits, as well. After its first year of implementing a green cleaning program, a public school district in Syracuse, New York found attendance increased by 11.7 percent and generated more than \$2.5 million in additional state funding to the school district.<sup>24</sup> Of greater importance, numerous studies have shown better student attendance is correlated with greater student achievement.

By using green cleaning methods, schools may also decrease their job

**Table 1.** Conventional cleaning agents and their health risks

Product	Hazardous Ingredients	Health Or Environmental Concern
<i>Glass cleaners</i>	2-butoxyethanol (ethylene glycol mono-butyl ether)	A solvent that can be absorbed through the skin and inhaled. Can damage the blood, kidney and nervous system.
	Methyl, ethyl, and isopropyl alcohol	Respiratory irritants. Methanol is a nervous system irritant and optic nerve toxin. Some alcohols are poisonous.
	Ammonia (ammonium hydroxide)	Respiratory irritant that at high doses may damage the nervous, reproductive, and gastrointestinal systems. Produces a highly toxic gas when mixed with other cleaning products containing chlorine.
<i>Bleach</i>	Sodium hypochlorite	Eyes, skin, and airway irritation; when mixed with ammonia will produce a highly toxic gas.
<i>Metal polish</i>	Perchloroethylene	A solvent and possible human carcinogen as well as a reproductive and developmental toxin.
	Xylene	Considered a developmental, neurologic, reproductive, immune, and respiratory toxin.
<i>All purpose cleaner</i>	Cocamide diethanol-amine (DEA)	The DEA portion of cleaner may form nitrosamines, which are carcinogenic.
	Alcohol ethoxylate	The ethylation process is typically contaminated with 1,4-dioxane, a known carcinogen that is also toxic to the blood, liver, kidneys, and nervous and immune systems.
<i>Carpet &amp; spot remover</i>	2-Butoxyethanol Methyl, ethyl, and isopropyl alcohol	A solvent that can be absorbed through the skin and inhaled. Can damage the blood, kidneys, and nervous system.
	Perchloroethylene	See listing under “metal polish.”
<i>Floor finish</i>	Dibutyl phthalate	Commonly used plasticizer in floor finishes that is a suspected developmental, endocrine, and reproductive toxicant.
	Tributoxyethyl phosphate	Hydrolyzes to 2-butoxyethanol, see listing above under “carpet and spot remover.”
	Acrylic polymer	Most acrylic polymers use zinc, which can be a neurotoxin when it enters the environment after disposal.
	Diethylene glycol methyl ether	Suspected to be toxic to the developmental, endocrine, nervous, and gastrointestinal systems.


*Adapted from Ashkin and Ellis, 2006.*

injury rates. After transitioning to certified green cleaning products, California's Fairfield-Suisun Unified School District reported a significant decrease in the job injury rate for custodians.<sup>25</sup> Considering the cost per janitorial chemical injury claim (\$725 according to Washington State's 1999 worker compensation<sup>26</sup>) and the size of the average school district's full-time custodial, maintenance, and grounds staff (60),<sup>27</sup> there is ample opportunity for cost avoidance through better protections of worker's health.

## CONCLUSION

Ten states (New York, Illinois, Maine, Missouri, Connecticut, Maryland, Nevada, Hawaii, Iowa, and Vermont) and the District of Columbia have laws or voluntary guidelines advocating the use of green cleaning in school environments.<sup>28</sup> The adoption of such measures by these states suggests there is a growing level of awareness among state policymakers that green cleaning can help minimize student and staff exposures while potentially saving money and, in some instances, reducing student absenteeism potentially leading to higher student achievement.

There is substantial scientific evidence that children are particularly susceptible to the harmful effects of exposures to hazardous chemicals, and the implementation of green cleaning practices provides an important opportunity to reduce potentially harmful exposures to students and staff in school environments. While scientific studies of reduced health effects in schools following the implementation of green cleaning practices are limited, anecdotal reports suggest

green cleaning practices are associated with reduced health effects and improved school attendance. Green cleaning practices have also been shown to provide environmental benefits and can typically be implemented at equal or reduced costs from traditional cleaning methods. Together, these factors provide a strong case for the implementation of green cleaning methods in the nation's schools. 

<sup>1</sup>Stephen Ashkin and Richard Ellis, *Safe and Healthy School Environments* (New York, N.Y.: Oxford University Press, Inc., 2006), 169-188.

<sup>2</sup>Ibid.

<sup>3</sup>Ibid.

<sup>4</sup>U.S. EPA, *Child Specific Exposures Factor Handbook* (Final Report) 2008 (Washington, D.C.: U.S. Environmental Protection Agency).

<sup>5</sup>EPA; B. Eskenazi, A. Bradman, and R. Castorina, "Exposures of Children to Organophosphate Pesticides and Their Potential Adverse Health Effects," *Environmental Health Perspectives* 107, Suppl. 3 (June 1999): 409-419, <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1566222/?page=1>; S. Gurunathan, M. Robson, N. Freeman, et al., "Accumulation of Chlorpyrifos on Residential Surfaces and Toys Accessible to Children," *Environmental Health Perspectives* 106, no. 1 (Jan. 1998): 9-16, <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1532945/>; E. Nishioka, Y. Funasaka, H. Kondoh, A.K. Chakraborty, Y. Mishima, M. Ichihashi, "(1999) Expression of tyrosinase, TRP-1 and TRP-2 in ultraviolet-irradiated human melanomas and melanocytes: TRP-2 protects melanoma cells from ultraviolet B induced apoptosis," *Melanoma Research* 9, no. 5 (October 1999): 433-43.

<sup>6</sup>National Research Council Committee on Developmental Toxicology, *Scientific Frontiers in Developmental Toxicology and Risk Assessment* (Washington, D.C.: NRC, 2000).

<sup>7</sup>Rodney Dietert, Ruth Etzel, David Chen, Marilyn Halonen, et al., "Windows of Vulnerability for the Immune and Respiratory System," *Environmental Health Perspectives* 108, Suppl. 3 (June 2000): 483-490; Richard Harding, Kent Ed Pinkerton, and Charles Plopper, eds. *The Lung: Development, Aging and the Environment* (San Diego: Elsevier Academic Press, 1994).

<sup>8</sup>Brenda Foos and Babasaheb Sonoawane, "Overview: Workshop on Children's Inhalation Dosimetry and Health Effects for Risk Assessment," *Journal of Toxicology and Environmental Health, Part A* 71, no. 3 (2007):147-165.

<sup>9</sup>Thomas Bateson and Joel Schwartz, "Children's Response to Air Pollutants," *Journal of Toxicology and Environmental Health, Part A* 71, no. 3 (2007): 238-243.

<sup>10</sup>Ibid.

<sup>11</sup>Ibid.

<sup>12</sup>Dietert.

<sup>13</sup>U.S. Environmental Protection Agency, "Protecting Students and Staff with Green Cleaning," <http://www.epa.gov/osw/partnerships/sc3/pdfs/green-clean.pdf>.

<sup>14</sup>Lara Akinbami, Jeanne Moorman, and Liu Xiang, "Asthma Prevalence, Health Care Use, and Mortality: United States, 2005-2009," *National Health Statistics Reports*, no. 32 (Jan. 12, 2011), <http://www.cdc.gov/nchs/data/nhsr/nhsr032.pdf>.

<sup>15</sup>Thomas Barron, Berg C, and Bookman L. *Green Cleaning: How to Select and Use Safe Janitorial Chemicals*, <http://www.greenbiz.com/sites/default/files/document/CustomO16C45F42213.pdf>.

<sup>16</sup>Reinisch F, Harrison R., Cussler S., et al. "Physician Reports of Work Related Asthma in California, 1993-1996," *American Journal of Industrial Medicine* 39, no. 1 (January 2001):72-83.

<sup>17</sup>Barron.

<sup>18</sup>EPA "Protecting Students..."

<sup>19</sup>Stephen Ashkin, "Session I: The Financial Case for Cleaning," from Indoor Environment '98, <http://ashkingroup.com/pdfs/Education/Report%20-%20IAQ%20test%20study%202%20-%20children.pdf>.

<sup>20</sup>Environmental Working Group, *Greener School Cleaning Supplies = Fresh Air + Healthier Kids: New Research Links School Air Quality to School Cleaning Supplies*, <http://www.ewg.org/files/2009/10/school-cleaners/EWGschoolcleaningsupplies.pdf>; Green Purchasing Institute and Green Schools Initiative, "Frequently Asked Questions About the Cost of Certified 'Green' Cleaners," 2009, <http://bit.ly/xhsoOS>.

<sup>21</sup>Ibid

<sup>22</sup>Tina Adler, "Learning Curve: Putting Healthy School Principles into Practice," *Environmental Health Perspectives* 117, (Oct. 1, 2009): <http://ehp03.niehs.nih.gov/article/info%3Adoi%2F10.1289%2Fehp.117a448>.

<sup>23</sup>Ashkin and Ellis.

<sup>24</sup>Stephen Ashkin, "Session I: The Financial Case for Cleaning," from Indoor Environment '98, <http://ashkingroup.com/pdfs/Education/Report%20-%20IAQ%20test%20study%202%20-%20children.pdf>.

<sup>25</sup>EWG; RAMP (Regional Asthma Management & Prevention), *Breathing Easier: School Districts Make the Switch to Certified Green Cleaning Products*, <http://www.rampasthma.org/wp-content/uploads/2009/11/Breathing-Easier-Report.pdf>.

<sup>26</sup>Barron.

<sup>27</sup>Joe Agron, "38th Annual M&O Cost Study," *American School and University* (April 1, 2009), <http://asumag.com/Maintenance/school-district-maintenance-operations-cost-study-200904/>.

<sup>28</sup>Environmental Law Institute, "Green Cleaning in Schools Developments in State Policy," *Indoor Environments & Green Buildings Policy Resource Center*, [http://www.eli.org/Buildings/Green\\_Cleaning/index.cfm](http://www.eli.org/Buildings/Green_Cleaning/index.cfm).