ENVIRONMENTAL WORKING GROUP

Greener School Cleaning Supplies = Fresh Air + Healthier Kids

New Research Links School Air Quality to School Cleaning Supplies

EWG's air pollution tests of school cleaning supplies detected hundreds of contaminants, including six that cause asthma, 11 tied to cancer in people, and many more that have never been evaluated for safety.

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For more information, visit:
www.ewg.org/schoolcleaningsupplies

Executive Summary:

Green School Cleaners Emit Fewer Air Pollutants

Cleaning supplies used in 13 large California school districts release an airborne brew of chemicals, including a number that have been linked to asthma or cancer by state and federal health authorities. Tests of 21 cleaners from these schools conducted for the Environmental Working Group found that when used as directed, the products released six chemicals known to cause asthma, 11 contaminants that are known, probable, or possible cancer-causing substances in humans, and hundreds of other compounds for which there is little or no hazard information.

The school districts using these products are Bakersfield City and the unified districts of Fairfield-Suisun, Fresno, Jefferson (Daly City), Los Angeles, Oakland, Sacramento City, San Bernardino City, San Francisco, San Jose, Stockton, Visalia, and West Contra Costa County. Some of these districts have reduced their use of more toxic products by adopting or trying green cleaning supplies.

In all, air testing revealed 457 chemicals emitted by these products. While some of these airborne compounds are known to be hazardous, nothing is known about the health risks of most of them. Manufacturers' documents disclosed the presence of another 42 chemical ingredients that air testing could not pick up.

Statewide, cleaning supplies release 32 tons of contaminants into the air each day.

Some of the products tested are widely used in American households, including:

- **Comet Disinfectant Powder Cleanser**, which emitted 146 contaminants when used as directed, including formaldehyde, benzene, chloroform and four other chemicals identified by the state of California as causing cancer or reproductive harm.
- **Simple Green**, a general purpose cleaner that released 93 chemicals into the air, including two linked to cancer (2-butoxyethanol and acetaldehyde) and one linked to cancer and asthma (formaldehyde).
- **Febreze Air Effects**, an air freshener that gave off 89 airborne contaminants including acetaldehyde, a chemical linked to cancer.

EWG also tested several "green" cleaners used by school districts that have chosen to use products independently certified as being free of several harmful ingredients. The results showed that green cleaning supplies can reduce chemical exposure in two important ways:

- Green cleaners released a lower overall number of measurable air contaminants. The conventional cleaners analyzed produced three to five times more air contaminants than green general purpose cleaners.
- Green cleaners produced lower levels of one important class of air pollutants, volatile organic compounds (VOCs). Total VOC levels measured from conventional general purpose cleaners were six times higher than their green counterparts.

Even so, most green cleaning products could be a little greener. Although they emitted fewer potentially hazardous chemicals overall, our testing showed that some certified green products release measurable levels of substances that could pose a risk to children's health, indicating that the certification process is not airtight and needs to be continually upgraded.

Ingredients pose a health risk:

Among the hundreds of chemicals identified in the school cleaners were:

- Six known to cause asthma (formaldehyde, styrene, methyl methacrylate, ethanolamine, alkyl dimethyl benzyl ammonium chloride, and didecyl dimethyl benzyl ammonium chloride). Childhood asthma prevalence has more than doubled since 1980, and today nearly 10 percent of children have asthma.
- 11 that are known, probable, or possible human carcinogens (formaldehyde, styrene,

chloroform, trichloroethylene, benzene, 1-chloro-2,3-epoxypropane, acetaldehyde, N-ethyl-N-nitroso-ethanamine, 2-butoxyethanol, ethylbenzene, and quartz). Incidence of childhood cancer rose 28 percent from 1974 to 1998, with especially significant increases in leukemia, non-Hodgkin lymphoma, and several brain and nervous system cancers.

- 283 on which there is almost no scientific data, according to a review of the scientific literature. Outdated federal regulations do not require safety testing of all chemicals, resulting in a vast gap in knowledge about potential health risks of many substances in everyday products.

The alarming truth is that we know far too little about what's in the cleaning supplies used in schools – and in our homes. Legally, nearly any chemical can be used as an ingredient, and cleaning product labels are not required to list ingredients. Lacking a legal definition of words like "non-toxic," manufacturers can make misleading claims. As a result, school staff and consumers do not have the information they need to select products made with safer ingredients.

What about H1N1?

The H1N1 virus presents a unique situation that requires special precautions. We recommend that all schools follow the official guidance of the CDC and their local health authorities.

From the CDC:
http://www.flu.gov/professional/school/schoolguidancepdf.pdf

> Routine cleaning: School staff should routinely clean areas that students and staff touch often with the cleaners they typically use. CDC does not believe any additional disinfection of environmental surfaces beyond the recommended routine cleaning is required.

Specific Product Suggestions
EWG tested four products approved by EPA for controlling influenza A viruses like H1N1. Based on our tests of these approved products, we recommend Alpha HP as a preferred disinfection option, because it exposes children to few toxic chemicals. If schools use bleach as a disinfectant, we suggest that they not spray the product, as studies show that custodians and professional cleaners exposed to bleach spray products face increased risk of developing asthma.

What we can do to keep the air in classrooms clean:

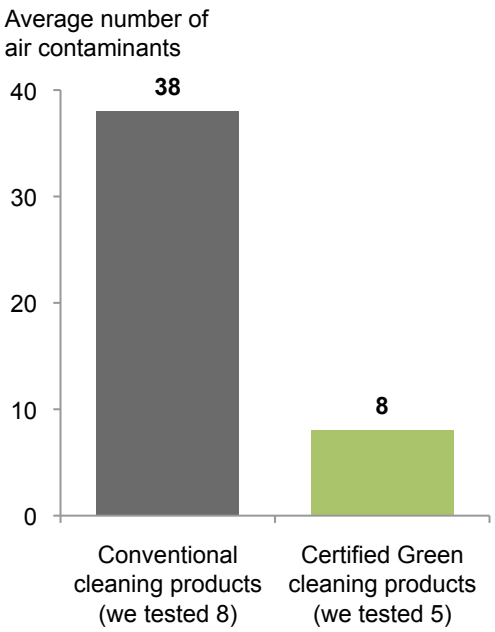
Parents
- Learn about your school's cleaning policy and educate school staff about certified green cleaning supplies.
- Follow EWG's tips for cleaning your home.
- Support local, state, and federal efforts to promote green cleaning in schools and to require safety testing and disclosure of ingredients.

Local, state, and federal governments
- Require use of certified green cleaning supplies in schools and other public buildings.
- Require disclosure of all ingredients on product labels.
- Require safety testing of chemicals in cleaners.

Manufacturers
- Disclose all ingredients on labels.
- Eliminate ingredients with known risks to health.
- Help schools pick kid-safe cleaning supplies.

Schools
- Make the switch to certified green cleaning products and practices and help other schools do the same.
- Ensure that all cleaning is done at times when students, including those staying for after-school programs, are not in the building.

General purpose cleaners: Conventional products are five times more polluting.



Best Cleaners: These certified green products released few air pollutants and none known to cause asthma or cancer

- Glance Non-Ammoniated Glass & Multi-Purpose Cleaner*
- Marauder Environmental General Purpose Cleaner

*There are many versions of Glance. Only Glance NA meets these criteria.

Worst Cleaners: These products released the largest number of air pollutants

- Comet Disinfectant Powder Cleanser
- Simple Green Concentrated Cleaner/Degreaser/Deodorizer
- Febreze Air Effects

Worst Product Types: These types released the largest number of air pollutants

- Graffiti Removers
- Air Fresheners
- Floor Finishes

Study Findings:

Classroom Cleaners Release 457 Air Pollutants

All across California, children spend many hours of the day in schools cleaned by products that can pollute classroom air. Cleaning supplies release 32 tons of contaminants into the air each day in California alone (CARB 2003; Nazaroff 2004).

EWG-commissioned tests of commonly used school cleaners reveal the wide range of chemicals children can breathe in each day at school. More than 20 products were selected based on a survey of the cleaning supplies used by several major California school districts, and tested individually by a leading laboratory that specializes in studying air pollution released by cleaning products. In a key part of this investigation, this state-of-the-art air quality laboratory cleaned a model classroom using multiple products at the same time, a first-of-its-kind test to measure the real-world pollution that occurs when typical assortments of cleaning supplies are used together.

The results are alarming. For example, some of the cleaning supplies used at home as well as at school release the highest number of contaminants measured. Some cleaners that appear "green" are anything but, misleading schools and consumers with marketing claims. Certified green cleaners, those meeting strict standards from independent groups, emit fewer contaminants on average and are safer choices for schools.

KEY FINDINGS:

- 457 distinct air contaminants were released by the 21 cleaning products tested. Comet Disinfectant Powder Cleanser emitted 146 contaminants, more than any other product tested. Glance NA, a certified green janitorial glass and general purpose cleaner, emitted just one air contaminant, the fewest detected.
- 24 of the chemicals found in these cleaners have well-established links to asthma, cancer, and other serious health concerns, including 12 of the State of California's Proposition 65 chemicals linked to cancer, birth defects, or reproductive toxicity.
- Certified green general purpose cleaners tested released an average of eight air contaminants, while those not certified released nearly five times as many, an average of 38 different contaminants each. Compared to conventional general purpose cleaners, the certified green products contained just one-quarter of the chemicals with documented ties to specific health concerns such as asthma and cancer. A comparison of all products tested shows certified green cleaning supplies released half as many air contaminants as conventional products, and contained one-third the chemicals with known health concerns.
- Cleaning a classroom with certified green products releases less than one-sixth of the total air pollution released by cleaning a classroom with conventional cleaners.

Cleaning supplies, dirty air:

EWG's testing of more than 20 cleaning products used in California schools detected a total of 457 chemicals released into the air. Limited information provided by manufacturers revealed the presence of 42 other chemical ingredients that were not measured in air samples, typically because they are not volatile. Manufacturers are legally required to disclose only a specific handful of cleaner ingredients due to acknowledged health concerns and occupational safety standards associated with each of them.

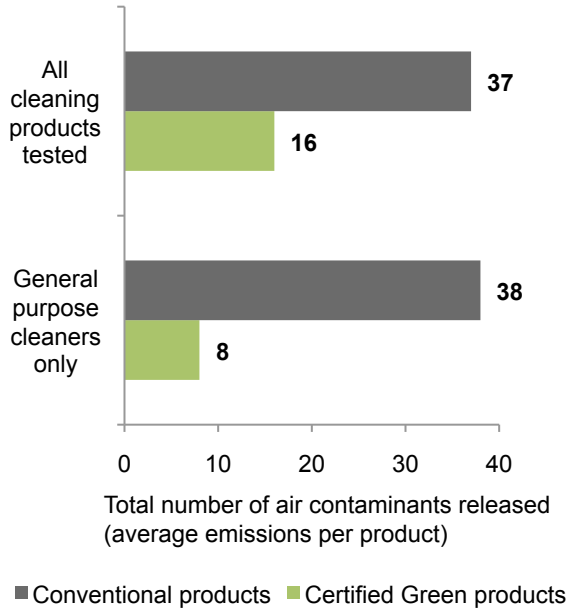
The results show dramatic variation in the numbers of contaminants released by each product tested: Comet Disinfectant Powder Cleanser emitted 146 distinct chemicals into the air, while a certified green glass and general-purpose cleaner, Glance Non-Ammoniated (NA) Glass and Multi-Purpose Cleaner, emitted just one air contaminant.

Some of the worst offenders, such as Comet Disinfectant Powder Cleanser, are household cleaning supplies commonly used in homes across America. When used at full-strength, the well-known cleaner Simple Green, which claims to be "non-toxic," gave off 93 different air contaminants; a Febreze Air Effects air freshener released 89.

Generally, certified green cleaning products released significantly fewer air contaminants than their conventional counterparts. On average, green general purpose cleaners released one-fifth as many contaminants as conventional general purpose cleaners. Broadening the comparison to include all cleaning supplies tested, certified green products emitted half as many contaminants as conventional cleaning supplies.

Especially polluting cleaning product types included air fresheners, graffiti removers, and floor finishes.

Certified green cleaning supplies release fewer air contaminants.



Source: Air pollution test results for school cleaning supplies. Note: Certified Green Products included in EWG tests are those certified by Green Seal or EcoLogo (Green Seal 2008; EcoLogo 2007, 2008).

Cleaning products can affect our health:

Twenty four air contaminants detected by EWG tests may cause asthma, cancer, and other serious health concerns affecting children and adults, according to U.S. and international health agencies. Seven more toxic cleaning chemicals that can linger on surfaces and contaminate dust are disclosed as ingredients by product manufacturers.

Ten of the products tested contained one or more of the chemicals known to the State of California to cause cancer or reproductive or developmental toxicity: Alpha HP Multi-Surface Cleaner, Citrus-Scrub 90, Comet Disinfectant Powder Cleanser, Febreze Air Effects, Goof Off Cleaner (CA VOC Compliant), Pine-Sol Brand Cleaner (Original), Pioneer Super Cleaner, Shineline Seal Floor Sealer/Finish, Simple Green Concentrated Cleaner/Degreaser/Deodorizer, and Waxie Green Floor Finish. Twelve of these toxic chemicals, known widely as Proposition 65 chemicals, are found in the cleaning supplies we tested, including:

- Benzene, a solvent and contaminant linked to cancer and male reproductive system toxicity (Comet Disinfectant Powder Cleanser)
- Chloroform, a gas that causes cancer and developmental toxicity (Comet Disinfectant Powder Cleanser)
- Dibutyl phthalate, an emulsifier known to damage developing male and female reproductive systems (Shineline Seal Floor Sealer/Finish).
- Formaldehyde, a cancer-causing gas also emitted by some building materials and furniture (Simple Green Concentrated Cleaner/Degreaser/Deodorizer, Pine-Sol Original Cleaner, Comet Disinfectant Powder Cleanser, Super Cleaner Concentrate)

Comet Disinfectant Powder Cleanser alone emitted seven Proposition 65 chemicals.

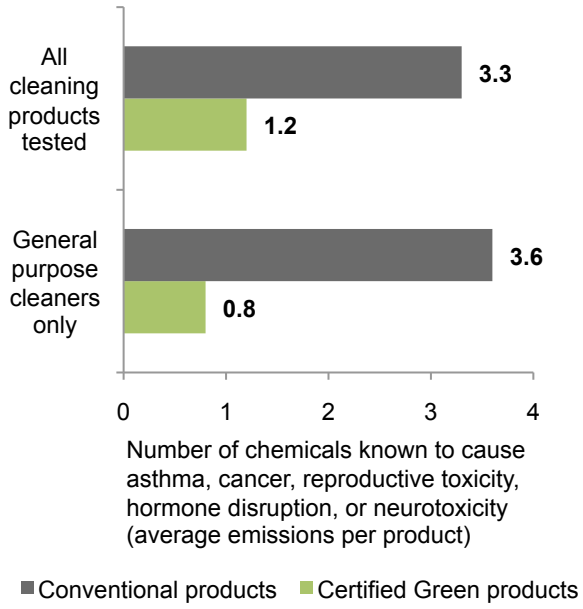
Products that expose users to Proposition 65 chemicals above legally prescribed levels must be clearly labeled as such under the law, to allow individuals and institutions such as schools to choose safer products. Recently, the manufacturer of the graffiti remover Goof Off was successfully sued by a public interest law firm because its Proposition 65 warning label was insufficient (As You Sow v. The Valspar Corporation, 2008). The Goof Off purchased for this study featured an appropriate Proposition 65 warning on the product.

Certified green products contained fewer known

toxic ingredients, according to EWG's laboratory tests and company documents. On average, green general purpose cleaners contained one-fourth as many chemicals with documented health concerns as similar conventional products. Among all cleaning supplies tested, certified green products contained one-third the chemicals with documented health concerns.

Leading green certifications include Green Seal (GS-37, Environmental Standard for Industrial and Institutional Cleaners) and EcoLogo (CCD-146, standard for Hardsurface Cleaners, and CCD-147 standard for Hard Floor Care Products). Green Seal GS-37 and EcoLogo CCD-146 establish

Certified green cleaning supplies contain fewer chemicals with documented health concerns.



Source: Air pollution results for school cleaning supplies.
Note: Certified Green Products included in EWG tests are those certified by Green Seal or EcoLogo (Green Seal 2008; EcoLogo 2007, 2008). Chemicals highlighted are those listed by leading authorities on asthma, cancer, reproductive toxicity, hormone disruption, and neurotoxicity, and are listed and documented in the Table below.

environmental and health requirements for general purpose, restroom, glass, and carpet cleaners, intended for routine cleaning of schools, offices, and institutions. EcoLogo CCD-147 establish similar requirements for floor polish, strippers and other floor maintenance products. The cleaning product criteria state that certified products will not contain ingredients that are carcinogens, mutagens, or reproductive toxins; heavy metals such as lead and cadmium; common cleaning chemicals of concern including 2-butoxyethanol, alkylphenol ethoxylates, and phthalates; ozone-depleting chemicals; and optical brighteners. Green Seal's standard was recently revised to include a prohibition on chemicals that are known to cause asthma through a process called respiratory sensitization. (Green Seal has also established a GS-40 floor care products standard, with less stringent criteria than those outlined above.) The EcoLogo standard also prohibits a number of ingredients based on their suspected hormone-disrupting properties.

Green Seal and EcoLogo standards, which are revised periodically, also establish specific limits on ingredients for acute toxicity; skin absorption; inhalation toxicity; toxicity to aquatic life; bioaccumulating compounds; nutrient pollution; and fragrances. Additional criteria in these standards also limit a product's pH, combustability, volatile organic compound (VOC) content, and biodegradability. The criteria define requirements for concentrates; dispensing systems; packaging; recyclability; labeling; and training. These particular standards do not include cleaners for household use, and do not apply to air fresheners, graffiti removers, or to disinfecting or "antimicrobial" cleaners.

Despite these standards, some certified products did emit asthmagens, carcinogens, and reproductive toxins. Some of these offending products were certified under earlier versions of a green standard and have not yet been reformulated to reflect the latest standard. Others emit toxic chemicals still allowable under their particular certification standard, and some release chemicals specifically prohibited as ingredients according to their own certification. Just two of six green products were completely free of all the asthmagens, carcinogens, and reproductive toxins addressed by current standards, according to EWG tests. Just 1 of 16 conventional products tested was free of all of these chemicals.

Dozens of chemicals in cleaning supplies are tied to human health risks.

Health Concern	Chemicals detected by EWG tests or disclosed as ingredients	Products containing one or more of these chemicals (number of relevant chemicals)
Asthmagens: chemicals that can trigger the development of asthma in previously asthma-free individuals – 6 chemicals from 10 school cleaners	Alkyl dimethyl benzyl ammonium chloride (ADBAC) Didecyl dimethyl benzyl ammonium chloride Ethanolamine Formaldehyde Methyl methacrylate Styrene	3M Brand Glass Cleaner (Product No. 1, Twist 'n Fill System) (1) Comet Disinfectant Powder Cleanser (1) NABC Non-Acid Disinfectant Bathroom Cleaner (1) Pine-Sol Brand Cleaner (Original) (1) Pioneer Super Cleaner (2) Ripsaw (1) Shineline Seal Floor Sealer/Finish (1) Simple Green Concentrated Cleaner/Degreaser/Deodorizer (1) Virex II 256 (1) Waxie Green Floor Finish (1)
Carcinogens: 11 chemicals from 11 school cleaners	Acetaldehyde Benzene 2-Butoxyethanol 1-Chloro-2,3-epoxypropane Chloroform Ethylbenzene Formaldehyde N-Ethyl-N-nitroso-ethanamine Quartz* Styrene Trichloroethylene	Citrus-Scrub 90 (1) Comet Disinfectant Powder Cleanser (7) Febreze Air Effects (1) Glance HC Glass and Multi-Surface Cleaner (1) Goof Off Cleaner (CA VOC Compliant) (1) Pine-Sol Brand Cleaner (Original) (1) Pioneer Super Cleaner (2) Shineline Seal Floor Sealer/Finish (1) Simple Green Concentrated Cleaner/Degreaser/Deodorizer (3) Waxie 21 Glass Cleaner (1) Waxie Green Floor Finish (1)
Reproductive Toxins: 4 chemicals from 4 school cleaners.	Benzene Dibutyl phthalate* Ethoxyethanol Toluene	Alpha HP Multi-Surface Cleaner (1) Comet Disinfectant Powder Cleanser (2) Goof Off Cleaner (CA VOC Compliant) (1) Shineline Seal Floor Sealer/Finish (2)

Hormone Disruptors: 8 chemicals from 9 school cleaners	Benzophenone 1-Chloro-2,3-epoxypropane Dibutyl phthalate* Ethylene glycol N,N-Dimethylformamide Nonylphenol ethoxylate* Phenol Styrene	3M Brand Glass Cleaner (Product No. 1, Twist 'n Fill System) (1 Clorox Regular Bleach (1) Comet Disinfectant Powder Cleanser (2) Glance HC Glass and Multi-Surface Cleaner (1) Goof Off Cleaner (CA VOC Compliant) (2) Shineline Seal Floor Sealer/Finish (3) Simple Green Concentrated Cleaner/Degreaser/Deodorizer (2) Twister (1) Waxie 21 Glass Cleaner (1)
Neurotoxins: 17 chemicals from 15 school cleaners	Acetone* Benzene Benzonitrile Benzyl alcohol Chloroform Cyclohexanone Dibutyl phthalate* N,N-Dimethylformamide Ethyl acetate Isopropyl alcohol Methyl ethyl ketone Methyl methacrylate Phenol Styrene Toluene Trichloroethylene Xylene	3M Brand Bathroom Cleaner (Product No. 44, Twist 'n Fill System) (1) Alpha HP Multi-Surface Cleaner (1) Citrus-Scrub 90 (1) Clorox Regular Bleach (1) Comet Disinfectant Powder Cleanser (5) Febreze Air Effects (1) Goof Off Cleaner (CA VOC Compliant) (4) NABC Non-Acid Disinfectant Bathroom Cleaner (1) Pine-Sol Brand Cleaner (Original) (1) Ripsaw (1) Shineline Seal Floor Sealer/Finish (3) Simple Green Concentrated Cleaner/Degreaser/Deodorizer (1) Virex II 256 (1) Waxie 21 Glass Cleaner (1) Waxie Green Floor Finish (1)

Note: Certified Green Products included in EWG tests are those certified by Green Seal or EcoLogo (Green Seal 2008; EcoLogo 2007, 2008). Chemicals highlighted are those listed by leading authorities on asthma, cancer, reproductive toxicity, hormone disruption, and neurotoxicity, and are listed and documented in the Table below.

*Chemicals not detected in air contaminant tests, but disclosed as ingredients by manufacturers

Asthmagens identified by the Association of Occupational and Environmental Clinics (AOEC 2009).
Carcinogens identified by International Agency for Research on Cancer (IARC) as known, probable, reasonably anticipated, or possible human carcinogens (IARC; Groups 1, 2A, and 2B), the National Toxicology Program (Groups 1 and 2), the EPA Integrated Risk Information System (weight-of-evidence classifications A, B1, B2, C, carcinogenic, likely to be carcinogenic, and suggestive evidence of carcinogenicity or carcinogen potential), or the Occupational Safety and Health Administration (as carcinogens under 29 CFR 1910.1003(a)(1))
Reproductive toxins identified by the State of California under the Safe Drinking Water and Toxic Enforcement Act of 1986

(California Code of Regulations, Title 22, Division 2, Subdivision 1, Chapter 3, Sections 1200, et. seq., also known as Proposition 65).
Hormone disruptors identified by the European Union in Appendix 9 of Towards the Establishment of a Priority List of Substances for Further Evaluation of Their Role in Endocrine Disruption (European Commission DG ENV 2000, 2007)
Neurotoxins identified in literature review by Grandjean and Landrigan (2006).

While it is troubling to note the presence of chemicals linked to health risks in the majority of the cleaners tested, a higher level of concern may be appropriate for those chemicals disclosed by manufacturers. Cleaning product makers typically disclose only those ingredients both tied to specific occupational health risks and making up more than one percent of the product, or 0.1 percent if the ingredient is a carcinogen. Thus, chemical ingredients disclosed by companies are typically primary ingredients present at significant concentrations, rather than trace contaminants present at much lower levels.

Some key chemicals of concern in cleaning supplies:

Many conventional cleaning products rely on a relatively small set of chemical ingredients linked to serious health concerns. Highlighted below are two chemicals commonly detected in the air following cleaning, as well as a class of chemicals frequently found in cleaners.

Formaldehyde

Detected in:

- Comet Disinfectant Powder Cleanser
- Pine-Sol Brand Cleaner
- Pioneer Super Cleaner
- Simple Green Concentrated Cleaner/Degreaser/Deodorizer

Recognized as a "known" human carcinogen by the International Agency for Research on Cancer (IARC 2004), formaldehyde is a common indoor air contaminant released by cleaning products, as well as by other school and consumer goods, including plywood or particle-board furniture, building materials, and nail polish. The California Air Resources Board's Scientific Review Panel has concluded that there is no safe level of exposure to this cancer-causing chemical (CARB 1992).

Formaldehyde can form indirectly when terpenes from pine- and citrus-based cleaners react with trace levels of ozone in the air. For this reason, the California Air Resources Board recommends avoiding use of citrus and pine oil cleaners, especially on smoggy days when levels of ozone are high (CARB 2008).

Formaldehyde is "generally accepted" as an asthmagen by the Association of Occupational and Environmental Clinics (AOEC 2009). Cleaning products certified by Green Seal must not contain ingredients that AOEC defines specifically as sensitizer-induced asthmagens (chemicals that induce asthma by sensitizing, rather than irritating, the respiratory system), a designation that the organization has not assigned to formaldehyde. As a result, this chemical is not prohibited as an asthmagen according to the current Green Seal certification, although it is prohibited as a carcinogen. Formaldehyde is highly corrosive, capable of damaging eyes, skin, and lungs.

2-Butoxyethanol (also known as ethylene glycol monobutyl ether or EGBE)

Detected in:

- Glance HC Glass & Multi-Surface Cleaner
- Goof Off Cleaner (CA VOC Compliant)
- Pioneer Super Cleaner
- Shineline Seal Floor Sealer/Finish
- Simple Green Concentrated Cleaner/Degreaser/Deodorizer
- Waxie 21 Glass Cleaner
- Waxie Green Floor Finish

Many chemicals within the glycol ether family are linked to impaired fertility and reproductive and developmental toxicity in animal studies (EPA 2000; NTP 2000) and four are on California's Proposition 65 list of male developmental toxins. Occupational studies indicate that men exposed to glycol ethers on the job are more likely to have reduced sperm counts, while pregnant women exposed on the job

are more likely to give birth to children with birth defects (Cordier 1997; CDHS 2007). These solvents can reach toxic levels in the body by being readily absorbed through the skin or via inhalation; glycol ether solvents can damage the lungs and may be linked to asthma.

2-Butoxyethanol is a glycol ether that is commonly found in cleaning supplies. Exposure to 2-butoxyethanol can damage red blood cells, which could lead to anemia (NTP 2000). It is a "possible" human carcinogen (EPA 1999), and may be toxic to the reproductive system as well (NTP 2000). Routine home cleaning using 2-butoxyethanol cleaners can result in air contamination that exceeds established health-based limits for the workplace (Nazaroff 2006). This chemical is specifically prohibited in the certified green cleaners tested.

Quaternary ammonium compounds (quats, including alkyl dimethyl benzyl ammonium chloride and didecyl dimethyl benzyl ammonium chloride)

Disclosed as ingredients of:

- NABC Non-Acid Disinfectant Bathroom Cleaner
- Virex II 256

Many other chemicals of concern commonly found in cleaning supplies cannot be detected by air pollution tests because they do not vaporize into the air. Instead, these chemicals form residues that remain on desks, floors, and other cleaned surfaces. These chemicals can adhere to children's skin, including their hands, where exposure can occur through ingestion or absorption through the skin. These chemicals may also build up in dust, leading to exposures through inhalation, ingestion, and skin absorption.

For example, residues of non-volatile quaternary ammonium compounds (quats) in cleaning products can cause or exacerbate asthma (AOEC 2009). Surveys of house cleaners, health care workers, and others link exposure to quat-based cleaners to asthma symptoms and the development of work-related asthma (Preller 1996; Purohit 2000; Rosenman 2003; Delclos 2007). A quat-based disinfectant called Virex, similar to one used in multiple school districts in California and tested in this study (Virex II 256), was recently identified by noted scientist Dr. Patricia Hunt as the cause of a severe decline in the fertility of a laboratory mouse population — preliminary evidence that quats may be reproductive toxins (Hunt 2008). Recent tests using human blood cells also indicate that quats can damage DNA at levels far below those found in cleaning products (Ferk 2007). Overuse of quats may lead to development of antimicrobial resistance; bacterial colonies specifically resistant to these antimicrobial agents have already been identified in food production facilities (Mullapudi 2008).

A note on disinfectants and flu:

The flu virus and other infectious diseases can spread easily in schools, and the emergence of the H1N1 "swine flu" this year has heightened concerns because it appears to be especially prevalent among children and young adults.

Most health authorities recommend frequent hand washing and careful cleaning as the best ways to reduce the risk of flu. In particular, the Centers for Disease Control and Prevention (CDC) and the California Department of Public Health (CDPH) recommend regularly cleaning and sanitizing all areas and items that are likely to be frequently touched and immediate cleaning of visibly soiled areas (CDC 2009; CDPH 2009). Both agencies endorse recommendations by the American Academy of Pediatrics (AAP 2009) calling for daily cleaning and sanitizing of surfaces such as desks, countertops, floors, and doorknobs.

Neither government agency recommends use of disinfectants beyond measures already in place to keep schools clean. Instead, they urge frequent hand washing and isolating sick students and staff as the best means to control the H1N1 virus (CDC 2009; CDPH 2009).

General purpose cleaners can remove significant numbers of infectious germs, and many schools also use disinfectants or less potent sanitizers that contain EPA-registered pesticides to further control the spread of communicable diseases. While judicious use of disinfectants and sanitizers may play a role in controlling the virus in schools, overusing them does

not provide any additional protection and can expose school children and staff to toxic chemicals. In addition, the American Medical Association warns that overuse of antimicrobial products could cause germs to develop resistance to useful antibiotics and make them ineffective (Tan 2002). When disinfectants or sanitizers are used, they should be carefully selected to minimize children's exposures to toxic ingredients while achieving the desired level of germ control. Depending on the product used and the setting, this may involve a) cleaning surfaces first to remove soil that can shelter germs from disinfection or sanitization, b) careful dilution of the product, preferably using automatic dilution equipment that controls its concentration, c) applying an appropriate amount to surfaces using tools that minimize waste, such as microfiber cloths, d) allowing the product to remain in place long enough (dwell time) to kill germs, and e) removing or rinsing away residues, according to the product label. It is crucial to train custodians how to use these products correctly to protect both school children and custodians themselves.

Under U.S. law, disinfectants cannot make "green" claims. Certified green cleaning products are intended to replace conventional cleaning agents, not disinfectants.

Real-world classroom cleaning – clear benefits to going green:

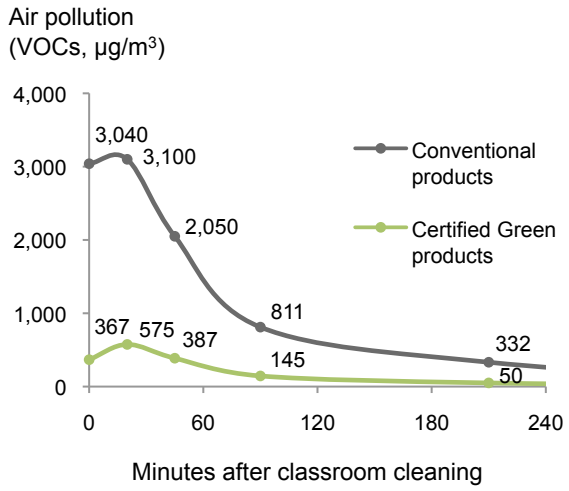
In a first-of-its-kind analysis, a leading air quality laboratory compared contaminants released when cleaning classrooms with typical assortments of conventional and green cleaning products. These tests clearly demonstrated that green products emit less than one-sixth of the pollution of conventional products. Previous studies typically examined cleaning compounds individually and failed to capture the real-world air contamination created by simultaneous use of multiple cleaning products.

Technicians, following carefully prescribed cleaning regimens based on findings from California's Air Resources Board (Nazaroff 2006), cleaned a model classroom with regular or green cleaning supplies. In the conventional classroom they mopped floors with Twister, wiped windows with Waxie 21 Glass Cleaner, and cleaned desks, bookshelves, and a whiteboard with Simple Green, simulating conventional cleaning with products widely used in California schools. In the green classroom, they mopped floors with Marauder Environmental Cleaner, wiped windows with Glance NA, and cleaned desks and other surfaces with Alpha HP (cleaner strength) – all products used in California school districts that have made the switch to green cleaners. The air quality laboratory pumped purified air through the model classroom chamber during and after cleaning at a rate of a room's worth of air per hour, and collected the outgoing air for analysis.

A total of 75 air contaminants were detected in these model classroom tests. The room-sized test chamber allowed scientists to both identify contaminants and measure their concentrations reliably. These classroom cleaning tests thus allow comparison of overall air pollution measured as total volatile organic compounds (VOCs), as well as comparison of the number of different air contaminants released.

The results are clear – levels of VOCs are less than one-sixth as high in the green classroom. The number of different individual chemical contaminants detected in the green classroom is one-third to one-fifth as high at every time point measured as well. Green cleaning products produced markedly safer, cleaner indoor air in the classroom – and are certified to perform at least as well as conventional cleaners.

Cleaning a classroom with green products releases one-sixth the overall air pollution.



Source: All measurements for conventional and green classroom cleaning scenarios may be found in the Data Appendix.
Conventional cleaning supplies used: Twister (floor), Waxie 21 Glass Cleaner (windows), Simple Green (desks and other surfaces).
GCertified green cleaning supplies used: Marauder Environmental Cleaner (floor), Glance Non-Ammoniated Glass & Multi-Purpose Cleaner (windows), Alpha HP Multi-Surface Cleaner (desks and other surfaces).

A key chemical of concern measured in the conventional cleaning scenario is 2-butoxyethanol, classified as a "possible" human carcinogen according to EPA (1999), with levels peaking at over 2,000 micrograms per cubic meter of air. This peak measurement is below government guidelines suggesting that levels of 2-butoxyethanol must be lower than 14,000 micrograms per cubic meter of air over a one-hour period to protect those exposed from eye and lung irritation (OEHHA 2008). This guideline was not designed to protect adults or children from increased risk of cancer; long-term exposures to 2-butoxyethanol may be a serious health concern at the lower levels.

Formaldehyde, a known human carcinogen, was detected at trace levels of around three micrograms per cubic meter of air, in both the conventional and green cleaning scenarios.

In addition, 15 air contaminants detected in the conventional cleaning scenario were not detected by any of the tests of individual products used to clean the classroom; in the green cleaning scenario, 10 new air contaminants were detected due to use of a mixture of green products. Trace levels of these chemicals may arise due to the interaction of the cleaning products with each other, or with the cleaning materials used to apply the products. Differences in detection may also stem from differences in sensitivity between the small-scale individual product tests and the larger-scale classroom cleaning test.

Impact on Kids' Health:

Students Face Health Risks from Air Contamination

Healthy indoor air is essential for any classroom. Yet a U.S. Department of Education survey revealed that 1 in 5 public schools in the U.S. have unsatisfactory indoor air quality, and 1 in 4 have inadequate ventilation (NCES 2007). A 2004 California Air Resources Board report on portable and traditional classrooms throughout the state found substandard levels of fresh air in classrooms during 40 percent of class hours, with seriously deficient ventilation 10 percent of the time (CARB 2004). As a result, nearly all classrooms tested contained hazardous contaminants like formaldehyde at levels above government guidelines designed to protect against cancer and other long-term health effects.

Children subjected to poor quality air at school are less healthy (Myhrvold 1996), less able to concentrate (Myhrvold 1996; Smedje 1996), and do worse on tests (Shaughnessy 2006). They also miss more days of school (Shendell 2004). A child's overall academic performance suffers with such illness or absence (Weitzman 1982; O'Neil 1985; Silverstein 2001). EPA advises schools to improve indoor air quality to increase both health and scholastic achievement (EPA 2003).

School staff should take a careful look at the cleaning supplies they use as one means of maintaining healthy air in the classroom. Some cleaners can be a significant source of indoor air pollution that harms air quality, causing asthma and other health problems in students, teachers, custodians, and staff. Chemicals in many conventional cleaning supplies used in schools in California have been linked to asthma, cancer, reproductive toxicity, hormone disruption, and neurotoxicity. After cleaning, chemical residues have been measured in air, on surfaces, in dust - and some of these chemicals have been detected in people's blood and urine, a clear indication of exposure.

Children's Asthma and Cleaning Supplies

CDC surveys have detected a dramatic increase in childhood asthma across the country in the span of just a few decades. At present, nearly 1 in 10 children (9.3 percent) has asthma in the U.S. (CDC 2008), up from 7.5 percent in 1996, and just 3.6 percent in 1980 (CDC 2006). In California, one in six children will develop asthma at some point during childhood or adolescence (Babey 2006). Childhood asthma is more common among African-American, Latino, and low income communities (CDC 2006; Babey 2007; Meng 2007). Hospitalization rates for asthma are at historically high levels, mirroring the documented trends in asthma prevalence (CDC 2006).

Childhood asthma affects education as well as health. Nationally, asthma is the leading cause of missed school days due to a chronic illness, accounting for one-third of these absences (EPA 1991). Asthma was responsible for an estimated 1.9 million missed school days in California in 2005 (Meng 2008), and approximately 14.7 million missed school days each year nationally (EPA 2005). Every school absence represents lost opportunities for learning and lost school revenue from the state. Is it possible that schools themselves may unintentionally contribute to growing rates of asthma through use of cleaning products containing ingredients known to cause asthma?

Many ingredients in conventional cleaning supplies cause asthma in previously healthy people, according to the Association of Occupational and Environmental Clinics (AOEC), the leading international body concerned with the link between chemical exposures and asthma. Examples of recognized asthmagens used in cleaning products include a class of surfactants called ethanolamines (like monoethanolamine, diethanolamine, and triethanolamine) and a class of antibacterial agents known as quaternary ammonium compounds (like benzalkonium chloride, or alkyl dimethyl benzyl ammonium chloride). More asthma-causing air contaminants specifically measured in EWG tests of cleaning supplies include formaldehyde, methyl methacrylate, and styrene. In addition, fragrances, which are common components of cleaners, are

among the top five allergens in the world (de Groot 1997; Jansson 2001), and are known to trigger asthma attacks (Norback 1995; Millqvist 1996).

Several studies also conclude that both occupational and non-occupational use of cleaning products are linked to increased risk of asthma (Medina-Ramon 2005, 2006; Arif 2009; Bernstein 2009). Teachers have high levels of asthma when compared to the general workforce (NIOSH 2004; Mazurek 2008), and a recent study of California and three other states noted that many teachers specifically report exposures to cleaning supplies in association with development of work-related asthma (Mazurek 2008).

Like teachers, school children spend a large part of their day inside classrooms cleaned with chemicals that can cause or exacerbate asthma, and breathe in a complex set of indoor air contaminants with lungs that are still developing. While many children outgrow their asthma diagnosis, childhood is a time of elevated sensitivity to irritating chemicals. According to the National Academy of Sciences, one factor in children's exceptional sensitivity to the harmful effects of chemicals is that their developing organ systems are more vulnerable to damage from chemical exposures (NAS 1993). The Academy also concluded that children are less able than adults to detoxify and excrete chemicals.

In addition, a child's chemical exposures are greater pound-for-pound than those of an adult (NAS 1993). On a body weight basis, for example, a resting child breathes up to twice as much air as adults (EPA 2008) - an important factor when considering the effects of air pollution in the classroom. Finally, the National Academy of Sciences notes that children have more years of future life in which to develop disease triggered by early exposure (NAS 1993).

Green Seal, an independent group that certifies green cleaners, has taken into account children's special susceptibility to toxic air contaminants in designing its cleaning product standards (Green Seal 2008). According to the latest version of Green Seal's certification standard, certified green products are prohibited from containing ingredients classified by AOEC as both asthmagens and sensitizers.

EcoLogo, another independent green certification company, specifically prohibits a number of typical cleaning product ingredients found on the AOEC list (EcoLogo 2008). While green cleaning products generally contain far fewer asthmagens than conventional products, air contaminant tests did detect one such chemical, methyl methacrylate, in the EcoLogo-certified Waxie Green Floor Finish. This chemical is not specifically prohibited by EcoLogo criteria, suggesting that a more comprehensive prohibition of AOEC asthmagens might strengthen the EcoLogo standard and better protect public health.

Cleaning products also contribute to asthma indirectly, by releasing a host of volatile organic compounds (VOCs) that form ozone when in the presence of other widely distributed air contaminants composed of nitrogen and oxygen. Ozone is the primary component of smog that can trigger asthma. Ozone was not detected in this study because the VOCs emitted by cleaning products were exposed to purified air free of nitrogen-oxygen air contaminants. These common contaminants undoubtedly affect the air in classrooms across the U.S., providing an opportunity for ozone formation during and after use of cleaning supplies that release VOCs.

Use of cleaning products can release volatile organic compounds at levels up to 100 times higher than found outdoors; these levels can even exceed safety limits established for industrial settings (Nazaroff 2006). So many of these volatile organic compounds are capable of producing ozone that estimates of smog-forming VOCs can be made by measuring the total level of all VOCs emitted, then subtracting methane, a single nonreactive volatile compound, from this measurement.

Recent research indicates exposure to ozone can be especially harmful for children. A six-month study of fourth graders in 12 southern California communities documented an 83 percent increase in respiratory-related absences when daytime ozone levels increase by 20 parts per billion (Gilliland 2001). Children who grow up in smoggy regions have permanently scarred lungs, and feel lifelong effects of diminished lung capacity

(Kunzli 1997). For this reason, certification organizations place strict limits on the levels of volatile organic compounds emitted by green cleaning products.

Volatile chemicals known as terpenes, derived from pine and citrus oil cleaners, produce another asthma risk. Terpenes can react with trace levels of ozone to form formaldehyde, an asthmagen and known human carcinogen. The California Air Resources Board recommends avoiding use of citrus and pine oil cleaners, especially on smoggy days (CARB 2008).

The annual direct medical cost of asthma in both children and adults is estimated at $37 billion nationwide (Kamble 2009). The indirect costs for an individual child are difficult to quantify, but encompass impacts on a child's education and well-being from asthma caused or triggered by cleaning products. And asthma is just one of many long-term health consequences associated with cleaning product chemicals.

Chemicals in Cleaning Supplies Raise Other Health Concerns

Individual chemicals found in cleaning products are tied to a number of other serious human health threats, according to numerous laboratory studies and, in some cases, research on exposure and disease in people.

Cancer

Increasing incidence of many childhood cancers, including leukemia, non-Hodgkins lymphoma, and specific brain and nervous system cancers (Woodruff 2004; Ries 2007), are a clear cause for concern regarding children's exposures to chemicals linked to cancer. Air pollution tests of cleaning products used in schools, along with limited ingredient disclosure, revealed a total of 11 cleaner chemicals classified as known, probable, or possible human carcinogens.

For example, Comet Disinfectant Powder Cleanser released benzene, formaldehyde, chloroform, and three more cancer-causing chemicals. An additional carcinogen, quartz, was not detected by testing, but is disclosed as an ingredient by the manufacturer. Quartz is an inhalation carcinogen. School children are unlikely to inhale quartz powder present in cleaning products, but custodians may experience more substantial exposures. The widely used graffiti remover Goof Off emitted ethylbenzene and 2-butoxyethanol, both linked to cancer.

Green Seal-certified cleaning supplies cannot contain ingredients classified as carcinogenic by the Environmental Protection Agency (EPA), the National Toxicology Program (NTP), the Occupational Safety and Health Administration (OSHA), or the International Agency for Research on Cancer (IARC). These products also cannot contain ingredients known to produce or release these carcinogenic compounds (Green Seal 2008). EcoLogo prohibits formulation or manufacture of certified green cleaning products with any carcinogens listed by IARC (EcoLogo 2008).

While 10 of 16 conventional products emitted carcinogens, just one of six certified green cleaning products, Waxie Green Floor Finish, emitted any of these cancer-causing chemicals. The chemicals emitted by this green product are specifically prohibited by the green standard it is certified to meet (EcoLogo 2007), implying an inconsistency between the manufacturer's disclosures concerning formulation and the actual chemicals released by the product. If green certifying groups required air testing results for certification, such inconsistencies could be detected and resolved immediately. That would ensure that certified green products did not emit substances prohibited by their certification standards, resulting in safer, healthier, and more trustworthy green cleaning supplies.

Carcinogenic chemicals prohibited in certified green products are released by 10 conventional cleaners, and by one green cleaner.

Carcinogen	Cleaning Product
Acetaldehyde (1,2,3)	Comet Disinfectant Powder Cleanser Febreze Air Effects Simple Green Concentrated Cleaner/Degreaser/Deodorizer Waxie Green Floor Finish
Benzene (3,4,5)	Comet Disinfectant Powder Cleanser
2-Butoxyethanol (6)	Glance HC Glass and Multi-Surface Cleaner Goof Off Cleaner (CA VOC Compliant) Pioneer Super Cleaner Shineline Seal Floor Sealer/Finish Simple Green Concentrated Cleaner/Degreaser/Deodorizer Waxie 21 Glass Cleaner Waxie Green Floor Finish
1-Chloro-2,3-epoxypropane (1,3,7)	Comet Disinfectant Powder Cleanser
Chloroform (1,2,8)	Comet Disinfectant Powder Cleanser
Ethylbenzene (2)	Waxie 21 Glass Cleaner
N-Ethyl-N-nitroso-ethanamine (1,3,7)	Comet Disinfectant Powder Cleanser
Formaldehyde (1,4,9)	Comet Disinfectant Powder Cleanser Pine-Sol Brand Cleaner (Original) Pioneer Super Cleaner Simple Green Concentrated Cleaner/Degreaser/Deodorizer
Quartz* (4)	Waxie Green Floor Finish
Styrene (2)	Shineline Seal Floor Sealer/Finish
Trichloroethylene (1,7)	Citrus-Scrub 90

*Ingredient disclosed by manufacturer but not detected in air contaminant tests
(1) NTP reasonably anticipated to be a human carcinogen
(2) IARC possible human carcinogen (Group 2B)
(3) EPA IRIS probable human carcinogen (Group B2)
(4) IARC known human carcinogen (Group 1
(5) EPA IRIS known human carcinogen (Group A)
(6) EPA IRIS possible human carcinogen (Group C)
(7) IARC probable human carcinogen (Group 2A)
(8) EPA IRIS likely to be carcinogenic to humans (high-exposure conditions only)
(9) EPA IRIS probable human carcinogen (Group B1)

Allylanisole, a carcinogen identified in California's Proposition 65 list but not on any of the agency lists specified in existing certification standards, was detected in the conventional cleaner Simple Green. This chemical is typically extracted from plant sources and can be used as a component of fragrances at low levels, among other uses. If certification groups included Proposition 65 chemicals in their list of prohibited carcinogens, their standards could be even more health protective.

Cleaning product ingredients can also be indirect sources of carcinogenic contamination. As described above, the known human carcinogen formaldehyde can form by mixing trace amounts of ozone in the air with terpenes, natural components of pine and citrus oil cleaners like Pine-Sol. Formaldehyde formation from terpenes is higher on smoggy days when ozone levels are high.

Reproductive Toxicity

Each year, about 7.3 million American couples have trouble becoming pregnant or carrying to full term, an increase of 20 percent over the last 10 years (Barrett 2006). Alarmingly, infertility is rising most rapidly for women under age 25. Increasing evidence indicates everyday exposures to reproductive toxins may play a role in escalating levels of infertility in the U.S.

Conventional cleaning supplies can contain a number of reproductive toxins. Phthalates, common ingredients in cleaner fragrances and in some floor finishes and window cleaners (WVE 2007), are reproductive toxins according to a number of animal studies (CERHR 2000; OEHHA 2007). In addition, epidemiological studies link a number of reproductive effects to phthalate exposure, including male reproductive system abnormalities (Swan 2005), altered sex hormone levels in baby boys and men (Main 2006; Duty 2005), and sperm damage in men (Duty 2003, 2004; Hauser 2007). Dibutyl phthalate is an ingredient in Shineline Seal Floor Sealer/Finish, one of the products examined in this study.

While phthalates may be present in other cleaning products tested, especially as components of fragrance, these chemicals are not sufficiently volatile to be measured as air contaminants. Instead, phthalates released by cleaners are likely to contaminate dust (Rudel 2003; CDC 2005). Exposures to toxins in dust are significant especially for younger children who are more likely to spend time sitting or playing on the floor (Butte 2002). According to the manufacturer, Shineline Seal Floor Seal/Finish contains up to five percent dibutyl phthalate, an alarmingly high level considering the potential this creates for children's exposure to a known reproductive toxin.

Dibutyl phthalate is a known reproductive toxin as defined by the state of California's Proposition 65 process. Other Proposition 65 reproductive toxins detected in these tests of cleaning supplies include solvents like toluene, benzene, and ethoxyethanol. These chemicals were detected in a total of four products, including one Green Seal-certified cleaner, Alpha HP. Green Seal-certified products must not contain Proposition 65 reproductive toxins as ingredients, nor can they contain ingredients known to produce or release these compounds (Green Seal 2008). In this case, testing data indicate a certified green product released trace levels of a prohibited compound, perhaps due to contamination of a product ingredient.

Other cleaner chemicals not yet listed as reproductive toxins in California are linked to reproductive harm. Glycol ethers, including the widely used 2-butoxyethanol, are common cleaning solvents that impair fertility and harm development in animal studies (EPA 2000; NTP 2000). Other studies find that men exposed to glycol ethers on the job are more likely to have reduced sperm counts, while pregnant women exposed on the job are more likely to give birth to children with birth defects (Cordier 1997; CDHS 2007). 2-Butoxyethanol was detected in six conventional cleaning products (Simple Green Concentrated Cleaner/Degreaser/Deodorizer, Glance HC Glass and Multi-Surface Cleaner, Shineline Seal Floor Sealer/Finish, Goof Off Cleaner (CA VOC Compliant), Pioneer Super Cleaner, and Waxie 21 Glass Cleaner), and one certified green product (Waxie Green Floor Finish). Only five cleaning products (Citrus-Scrub 90, Comet Disinfectant Powder Cleanser, Glance NA Glass & Multi-Purpose Cleaner, Marauder Environmental Cleaner, and NABC Non-Acid Disinfectant Bathroom Cleaner) were free of all

glycol ethers examined by laboratory tests.

Quaternary ammonium compounds (quats) are antibacterial pesticides commonly used in disinfectants. A quat-based disinfectant called Virex, similar to one used in multiple school districts in California, was recently identified by noted scientist Dr. Patricia Hunt as the cause of a severe decline in the fertility of a laboratory mouse population – preliminary evidence that quats may be reproductive toxins (Hunt 2008). Two disinfectants in this study, NABC Non-Acid Disinfectant Bathroom Cleaner and Virex II 256, both list quats as ingredients. Quats may be present in other products as well, as they are also used for their detergent properties. These chemicals are non-volatile and are expected to contaminate dust (Ferrer 2002). EcoLogo certified products are prohibited from containing quats.

EcoLogo certified products are prohibited from containing phthalates, quats, and some glycol ethers and their acetates (2-butoxyethanol, along with ethylene glycol monomethyl ether, ethylene glycol monoethyl ether, and ethylene glycol monopropyl ether) (EcoLogo 2007, 2008). The EcoLogo-certified product tested in this study, Waxie Green Floor Finish, emitted the prohibited ingredient 2-butoxyethanol.

For some certified green cleaning supplies, state-of-the-art air quality tests again highlight a discrepancy between ingredients disclosed to green certifiers and air contaminants emitted by these products. By requiring independent air contaminant testing as part of certification, Green Seal and EcoLogo would be able to verify that certified green products are free of many prohibited reproductive toxins, guaranteeing safer products.

Hormone Disruption

Signs of hormone disruption are evident in girls growing up all over America. Over the last four decades, the age at which girls begin to develop breasts has declined by one-to-two years (Steingraber 2007), with African-American girls typically developing at an earlier age than Caucasian girls. Over the same 40-year period, the age at which girls in the U.S. begin menstruating has declined by a few months, with substantial variation by ethnicity (Steingraber 2007). Early breast development, as well as the appearance of pubic hair at a young age, has become so common that in 1999 the clinical definition of early-onset or precocious puberty in the U.S. was reduced from age 8 to age 7 for Caucasian girls, and from age 7 to age 6 for African-American girls (Kaplowitz 1999).

A girl who begins puberty at an early age is at greater risk for several adult illnesses, including breast cancer (Wang 2005; Steingraber 2007; Golub 2008) and polycystic ovary syndrome (Ibáñez 1997; Kousta 2006; Steingraber 2007; Golub 2008), a leading cause of pelvic pain and infertility. Polycystic ovary syndrome is linked to increased risk of obesity, diabetes and impaired glucose tolerance (Auchus 2004; Kousta 2006), and increased prevalence of risk factors associated with cardiovascular disease (Kousta 2006).

Early-maturing girls are also more prone to a variety of psychiatric or behavioral problems, from depression to drug abuse and teen pregnancy (Graber 1997, 2004; Kaltiala-Heino 2001, 2003a, 2003b; Flanigan 2003; Deardorff 2005). Women experiencing early puberty tend to have less education (Johansson 2005), while late-maturing girls tend to perform better in school and are more likely to finish college (Graber 1997, 2004).

Scientists and medical professionals increasingly identify exposures to hormone-disrupting chemicals as a significant factor in unnaturally accelerating this critical period of development. Preliminary research on people suggests that exposures to one particular class of hormone-disrupting chemicals, phthalates, may be linked to early puberty in girls (Colon 2000).

Eight of the hormone-disrupting chemicals identified by a key European Commission report (European Commission DG ENV 2000, 2007) were detected as air contaminants or disclosed as ingredients of nine cleaners tested. Shineline Seal Floor Sealer/Finish contained three different suspected hormone disruptors (styrene, ethylene glycol, dibutyl phthalate), and two such chemicals were found in Comet Disinfectant Powder Cleanser (1-chloro-2,3-epoxypropane, benzophenone), Simple Green Concentrated Cleaner/Degreaser/Deodorizer (phenol, ethylene glycol), and Goof Off Cleaner (CA VOC

Compliant) (benzophenone, N-N-dimethylformamide).

Dibutyl phthalate and other phthalates are common ingredients in cleaning products and have well-documented hormone disrupting properties, according to laboratory tests and epidemiological studies (ATSDR 1995, 1997; CERHR 2000; Main 2006; Duty 2005; Huang 2007; Meeker 2007). Alkylphenols, breakdown products of widely used alkylphenol ethoxylate cleaner ingredients like nonyl phenol ethoxylate, are widely-acknowledged hormone disruptors implicated in the feminization of fish living in waterways receiving treated wastewater (Balch 2006; Zoller 2006; Barber 2007). Fragrances used in many cleaners can contain known or suspected hormone disruptors as well (EWG 2008).

Groups certifying green cleaning products have different ways of addressing hormone-disrupting chemicals. EcoLogo-certified products may not include chemicals listed in 2000 by the European Commission as candidates for evaluation of hormone-disrupting properties (European Commission DG ENV 2000), a list drawn from the rapidly emerging science on this critical health and environmental concern. However, phenol and ethylene glycol, two chemicals detected in these tests of cleaning product pollution, have been added to an updated version of this European list that is not included in the EcoLogo standard (European Commission DG ENV 2007). The Green Seal certification standard prohibits a few specific chemical classes, including phthalates and alkylphenol ethoxylates, due to hormone disruption concerns. By prohibiting a more up-to-date list of hormone-disrupting chemicals, EcoLogo and Green Seal could further improve product safety.

Hormone disruptors, some specifically prohibited in certified green products, are released by many cleaners.

Hormone Disruptor	Cleaning Product
Benzophenone	Comet Disinfectant Powder Cleanser Goof Off Cleaner (CA VOC Compliant)
1-Chloro-2,3-Epoxypropane	Comet Disinfectant Powder Cleanser
Dibutyl phthalate*	Shineline Seal Floor Sealer/Finish
Ethylene glycol**	3M Brand Glass Cleaner (Product No. 1, Twist ‘n Fill System) Glance HC Glass and Multi-Surface Cleaner Shineline Seal Floor Sealer/Finish Simple Green Concentrated Cleaner/Degreaser/Deodorizer Waxie 21 Glass Cleaner
Nonylphenol ethoxylate*	Twister
Phenol**	Simple Green Concentrated Cleaner/Degreaser/Deodorizer
Styrene	Shineline Seal Floor Sealer/Finish

Source: Potential hormone disruptors identified by the European Commission (European Commission DG ENV 2000, 2007)
*Chemicals disclosed as ingredients by manufacturers but not detected in air contaminant tests
**Potential hormone disruptors mentioned in the most recent European Comission candidate list, and not prohibited by the EcoLogo standard (EC 2007, EcoLogo CCD-146, 2008)

Neurotoxicity and Developmental Disabilities

In light of recent warnings suggesting that developmental disabilities stemming from exposures to neurotoxic chemicals may be a "silent pandemic in modern society" (Grandjean 2006), children require special protection from neurotoxins. Growth and development of the brain continues for many years after birth, leaving children uniquely sensitive to the effects of neurotoxic agents; in particular, dramatic changes to brain structure and function occur during adolescence (Golub 2000).

Examples of neurotoxins commonly used in cleaning products are benzyl and isopropyl alcohol, detected in NABC Non-Acid Disinfectant Bathroom Cleaner, Waxie 21 Glass Cleaner, and Ripsaw; isopropyl alcohol is also a known ingredient of Pine-Sol Original Cleaner. Although limits have been set for these chemicals in food, no limits are in place for cleaners.

A number of chemicals that incorporate chlorine are toxic to the brain and nervous system. Xylene is a neurotoxic component of certain heavy duty cleaning supplies, like Goof Off Cleaner (CA VOC Compliant) and Shineline Seal Floor Sealer/Finish, which are in use in California schools. Toluene and chloroform, both emitted by Comet Disinfectant Powder Cleanser, are also neurotoxic chemicals. Fragrances used in many cleaning products can contain ingredients suspected of neurotoxicity as well (USHR 1986).

Health-based limits exist regarding exposure to many neurotoxins in the workplace. These exposure limits, however, were designed only to protect against acute effects such as headache, and have not been tightened in decades despite recent scientific evidence of potential health effects of chronic, low-dose occupational exposures.

Neurotoxins are released by cleaning products, according to air contaminant tests and ingredient disclosures.

Neurotoxin	Cleaning Product
Acetone*	Goof Off Cleaner (CA VOC Compliant)
Benzene	Comet Disinfectant Powder Cleanser
Benzonitrile	Comet Disinfectant Powder Cleanser
Benzyl Alcohol	Ripsaw
Chloroform	Comet Disinfectant Powder Cleanser
Cyclohexanone	3M Brand Bathroom Cleaner (Product No. 44, Twist 'n Fill System) Virex II 256
Dibutyl phthalate*	Shineline Seal Floor Sealer/Finish
N,N-Dimethylformamide	Clorox Regular Bleach Goof Off Cleaner (CA VOC Compliant)
Ethyl acetate	Febreze Air Effects
Isopropyl alcohol	NABC Non-Acid Disinfectant Bathroom Cleaner Pine-Sol Brand Cleaner (Original)* Ripsaw Waxie 21 Glass Cleaner

Methyl ethyl ketone	Comet Disinfectant Powder Cleanser
Methyl methacrylate	Waxie Green Floor Finish
Phenol	Simple Green Concentrated Cleaner/Degreaser/Deodorizer
Styrene	Shineline Seal Floor Sealer/Finish
Toluene	Alpha HP Multi-Surface Cleaner Comet Disinfectant Powder Cleanser Goof Off Cleaner (CA VOC Compliant)
Trichloroethylene	Citrus-Scrub 90
Xylene	Goof Off Cleaner (CA VOC Compliant) Shineline Seal Floor Sealer/Finish

Source: Chemicals known to be neurotoxic according to Grandjean 2006.
*Chemicals disclosed as ingredients by manufacturers but not detected in air contaminant tests

Cleaning Products Pose Risks to School Custodians, Too

The custodial and operations staff working each day to provide California's children with a sanitary school environment receive the brunt of exposures to harmful chemicals in cleaning products. Cleaning professionals suffer a number of serious chemical injuries on the job. For example, 6 out of 100 janitors in Santa Clara County, California experience chemical-related injuries annually; 20 percent of these injuries are serious burns to the eyes or skin (Barron 1999).

Custodial staff experience increased incidence of asthma compared to those in other occupations (Zock 2001; NIOSH 2004; Medina-Ramon 2005; Jaakkola 2006). A recent study of work-related asthma in four states indicates that 12 percent of cases are associated with exposure to cleaning products (Rosenman 2003). Twenty two percent of those afflicted worked as janitors, and 13 percent worked in schools. Use of cleaning products can also exacerbate existing asthma; a recent study of asthmatic women who clean their own homes indicated increased asthma symptoms after housecleaning (Bernstein 2009). Across the state of California, asthma is responsible for an estimated 2 million days of missed work (Meng 2008), an indication of the severity of this public health crisis.

Government Action:

Children, Teachers and Custodians Lack Protections

School cleaning supplies can contain a broad range of chemical ingredients, many linked to significant health concerns including asthma and cancer. At this time, inadequate government health protections, combined with manufacturers' ability to conceal cleaning product ingredients, mean school staff often lack the information needed to make safer choices about the school cleaners they purchase.

Secret Ingredients

Take a look at a typical cleaning product, and you'll often see a label full of marketing claims and instructions for use. What's missing is a list of ingredients.

Unlike foods, beverages, and body care products, cleaning products need not be labeled with a list of ingredients. School staff and everyday consumers lack key information needed to select cleaning products made with safer ingredients.

Cleaning products must disclose certain kinds of information about ingredients. In the state of California, products containing chemicals known to cause cancer, birth defects, and other types of reproductive or developmental harm, the "Proposition 65" chemicals identified by the State, must include a warning on the product label if these chemicals are present above specified levels. Companies neglecting to properly label cleaning supplies have been successfully sued by citizens or by advocacy groups and forced to pay fines. Some advocates offer lower fines in their settlements to manufacturers that agree to reformulate products (As You Sow v. The Valspar Corporation, 2008). In addition, "antibacterial" cleaning products are classified as pesticides, and must list the name and quantity of all antimicrobial agents on the product label.

Schools and other institutions can obtain limited information on ingredients and associated health concerns from Material Safety Data Sheets (MSDSs), documents distributed by the manufacturer that outline safe storage and handling procedures for a product. These documents typically list only the handful of specific chemicals regulated by the Environmental Protection Agency (EPA) or the Occupational Safety and Health Administration (OSHA), and only when those chemicals are present in the product above one percent, or 0.1 percent in the case of carcinogens. MSDSs are designed with occupational exposures in mind, and do not address children's special sensitivity to chemical exposures.

Furthermore, these documents are often found to be out-of-date, inconsistent, and lacking critical information on chronic toxicity and carcinogenicity (Nicol 2008; Karstadt 2009). Many cleaner ingredients, including fragrances, dyes, and preservatives, are never listed, leaving school staff in the dark about what chemicals they're using to clean classrooms, bathrooms, and other school spaces. While a few companies have begun to disclose more information on the chemicals making up their cleaning supplies, most keep their ingredient information secret.

A lawsuit filed earlier this year may begin to correct this gap in cleaning product health protections. On behalf of public health and environmental advocacy groups, Earthjustice is suing Procter & Gamble, Colgate-Palmolive, and other cleaning product manufacturers for refusing to follow a New York State law passed in 1976 that requires them to disclose the chemical ingredients in their products and the health risks they pose. If successful, this lawsuit would force household and commercial cleaner companies selling products in New York to file semi-annual reports with the State listing the chemicals contained in their products, and describing any company research on these chemicals' health and environmental effects.

A legislative prescription is also in the works: U.S. Representative Steve Israel (D-N.Y.) introduced HR 3057 this year to require that all household cleaners be labeled with a full list of ingredients. This bill would not apply to "institutional" cleaners marketed specifically to schools, office

buildings, hospitals, and other institutions. U.S. Senator Al Franken (D- Minn.) has introduced the Senate version of this bill.

Faced with this pressure, the cleaning products industry has announced plans to disclose voluntarily many of the ingredients found in cleaning products. The Consumer Specialty Products Association (CSPA), Canadian Consumer Specialty Products Association (CCSPA) and the Soap and Detergent Association (SDA) recently announced an ingredient communication initiative designed to provide consumers with information about the ingredients in household cleaning products. Starting in January 2010, consumers will be able to call a toll-free number, consult a website or, for some products, check the label to find many major ingredients (Wayne 2009).

While partial, voluntary ingredient disclosure is a substantial improvement over the *status quo*, full, mandatory disclosure of all ingredients on product labels is essential to protecting public health. In addition, while voluntary ingredient disclosure may occur for household cleaners, it is unclear whether it will also occur for institutional cleaners.

Many States and Districts Support Green Cleaning in Schools

Lax federal health protections have fostered a variety of state efforts to promote green cleaning in schools. Eight states have passed laws on the subject:

- New York State's 2005 Green Cleaning Act (SB 5435) requires elementary and secondary schools to use green cleaning and maintenance products, under state guidelines.
- Illinois' 2007 Green Cleaning Schools Act (Public Act 095-0084) requires elementary and secondary schools to develop a green cleaning policy and purchase and use products consistent with state guidelines for green cleaning and maintenance products for schools. School districts that can prove that using green cleaners would pose a financial hardship may receive an exemption.
- Maine's 2007 Policy to Encourage the Use of Safe Chemicals in Public Schools (Legislative Document (LD) 88; S.P. Chapter 32) requires the State to publish information on green cleaning products and procedures, but does not mandate green cleaning in schools.
- Missouri's 2008 Green Cleaning for Schools Act (Revised Statutes 161.365; 2008 Mo. Sen. Bill 1181) requires the State to publish information on green cleaning products and procedures, but does not mandate green cleaning in schools.
- Maryland's 2009 Act Concerning County Boards of Education – Procurement of Green Product Cleaning Supplies (House Bill 1363) requires the State's elementary and secondary public schools to use cleaning products with positive environmental attributes. Local Boards of Education are responsible for defining what may be considered a green product.
- Connecticut's 2009 Green Cleaning Products in Schools Act (Public Act 09-81) requires elementary and secondary public schools to use certified green cleaning and maintenance products, according to state guidelines.
- Hawaii's 2009 House Bill 1538, Relating to Environmentally-Sensitive Products, requires the Department of Education to give first preference for Green Seal certified green cleaning products for use in elementary and secondary public schools.
- Nevada's 2009 Act Requiring School Districts to Use Certain Environmentally Sensitive Cleaning and Maintenance Products (Senate Bill 185) mandates that all public elementary and secondary schools ensure that only green cleaning and maintenance products are used to clean their floor surfaces. The State's Department of Education is required to adopt regulations that define green products and provide districts with a list of approved products. School districts that can prove that using green cleaners would pose a financial hardship may receive an exemption.

Bills on green cleaning in schools were also introduced this year in California, Massachusetts, Minnesota, Oregon, Rhode Island, and Vermont.

Many proactive school districts in California have already begun adopting green cleaning policies,

using certified green cleaners to maintain their facilities. Success stories show that green cleaning is effective, protects the health of students and staff, and can even save money.

Safer Cleaning Supplies Protect Everyone

By cleaning up the cleaning products industry, we can make schools safer for students – as well as custodians and teachers. Parents everywhere can take steps to protect their kids:

- Ask your school about its cleaning policy and practices. If they're not using certified green products, urge them to start cleaning green with these special tips for talking to schools. And when you're on school grounds, check to ensure the products in the custodial carts match school policy.
- Support state and local efforts requiring the use of certified green cleaners in schools.
- Spread the word about the secret ingredients in cleaning supplies, and fight for complete ingredient disclosure for all cleaning products.
- Don't stop with school – follow EWG advice on green cleaning at home.

Cleaning products are an appalling example of the inadequacy of current chemical protections. The U.S. Toxic Substances Control Act, the law that regulates all industrial chemicals in the United States, was enacted more than three decades ago, and assumes that chemicals in everyday products are safe until proven otherwise. Cleaning supplies and other everyday products can contain ingredients that have never been tested for safety. Lacking labeling requirements, consumers are even denied the right to know what's in the products they buy and use every day. Federal reform is needed to require companies to disclose all ingredients in cleaning supplies and other products, and to test these ingredients for safety.

Successful Green Cleaning:

Green Cleaning Does the Job

All across California, and indeed, all across the nation, schools have begun to turn to certified green cleaning supplies to provide students with a safer learning environment. Some of the many California school districts implementing large-scale green cleaning programs include Elk Grove Unified, Fairfield-Suisun Unified, and Fresno Unified. Other schools conducting green cleaning pilot programs include Los Angeles Unified, Oakland Unified, and San Francisco Unified. These success stories show that green cleaning is effective, protects the health of students and staff, and can save schools money.

Green Cleaners Really Clean

To be certified, a green cleaning product must pass strict performance tests. Elk Grove Unified, just south of Sacramento, transitioned from 15 different conventional cleaners to a single certified green cleaner that, at varying strengths, can clean just about every surface in a school (RAMP 2009). Linda Lopez, Manager of Custodial Services for Elk Grove, supervised the switch. After a demonstration from the product rep, she ordered a pilot test at Franklin High School. She reports, "I've also seen a lot of 'green' cleaners that don't perform. But this one [certified green cleaner] really works, and it's safe."

According to Richard Bonfond, chief custodian at Elk Grove's Joseph Sims Elementary School, "Some of the old products, you couldn't stand them they were so harsh, plus they didn't work as well. I prefer this new product. I like how it works for us. Just because you clean something doesn't mean it's clean. With this stuff, it's clean."

Green Products Are Healthier for Kids

School staff quickly see the health benefits provided by green cleaning supplies. For example, the same year that the new certified green cleaner was introduced to Elk Grove, absenteeism dropped 2 percent (RAMP 2009). "That's probably coincidental with attendance efforts on other fronts," said Linda Lopez, "but it [absenteeism] has been down significantly since then and it's stayed down."

Francis Kennedy, Custodial Manager of Fairfield-Suisun Unified, led the district's transition to green cleaning products (RAMP 2009). An asthmatic himself, Kennedy remembers that the traditional cleaners used in the district "had very powerful odors and children were affected by it." Following the transition to green cleaners, "The number of complaints we used to get about smells and odors, we don't get any more." With green cleaning in place, "The rooms became cleaner and the teachers noticed it. They didn't smell residual products after cleaning, which used to be a really big issue. When a room had an odor we used to spray a deodorizer that lingered for two to three days. We don't use products like that anymore."

Green cleaning is also safer for custodians. According to Kennedy, the job injury rate at Fairfield-Suisun's school sites also dropped significantly with the transition to certified green products. "We're not having the chemical accidents we used to have," he noted. "Job injuries mostly evaporated that first year."

Green Cleaning Can Save Money

Green cleaning need not cost schools any more money than conventional cleaning. On the contrary, many schools have saved money by making the switch. Fairfield-Suisun officials estimate that the new cleaning products and procedures have produced savings as high as 20 percent, in part due to labor savings from using restroom cleaning machines and autoscrubbers that dispense new green cleaning products (RAMP 2009).

Novato Unified School District in California's Marin County successfully transitioned to green cleaning products at all sites with no additional expense by working through its long-term contract with a local vendor (GPI 2009). "The market trend is that the costs for green products are going down, and having a long-term contract has helped us to lock-in prices and better manage our budget

projections," said Mark Silva, Director of Maintenance, Operations and Transportation for Novato Unified.

A money-saving advantage incorporated into the packaging of certified green cleaning supplies is that of automatic dilution equipment. Most certified green cleaning supplies are highly concentrated and a large percentage come with specially-engineered dilution control packaging or equipment to guarantee all products are used at appropriate concentrations. This creates a money-saving advantage over many conventional cleaning products by preventing waste caused by unmeasured pouring (the "glug-glug" method). Recently, two schools in Honolulu, HI were able to reduce the cost of their restroom cleaning products from $6-12 per gallon to less than $1 per gallon by replacing a ready-to-use conventional product with a highly-concentrated, Green Seal-certified product that is typically diluted with 64 to 256 parts water (GPI 2009).

Fairfield-Suisun Custodial Supervisor Francis Kennedy also reminds us that there are often additional, unquantified "savings in better indoor air quality, fewer job injuries due to toxic chemicals, and less damage to the facilities because of spills or misuse of the toxic product" (GPI 2009). Mary Curtin, a registered nurse at Martinez Unified School District, now using green bathroom cleaners, noted that, "The green products will most likely save district money with diminished school absences and improved employees' health" (GPI 2009).

New York and Illinois, the first states to mandate green cleaning in schools, have seen no adverse cost impacts from the legislation (GPI 2009). Kurt Larson of the New York State Office of General Services Environmental Services Unit, which spearheaded implementation of New York's 2005 *Green Cleaning in Schools Law,* has not heard any complaints from schools about the cost of green cleaners. "Since there are about 750 school districts in the state, if the requirement to use certified green cleaners was onerous, we would likely be hearing about it," Larson said. "Anecdotally, we're hearing that the green cleaning products work effectively and last longer, because they are concentrated and the dispensing systems are more accurate. In addition, the new products are usually implemented in conjunction with a comprehensive green cleaning program, often reducing the number of cleaning products required, which saves money."

The Illinois Green Clean Schools Act of 2007 was written to include an exemption clause that allows schools to opt out of the law's green cleaning requirements if they determine that they would increase their cleaning costs (GPI 2009). Mark Bishop of the Chicago-based Healthy Schools Campaign noted, "In follow up discussions with more than 25 districts, not a single facility manager told us that their costs increased. Most of the facility managers we spoke to said that while some elements of the green cleaning program cost more, some elements cost less; overall, green cleaning resulted in no additional cost. Additionally, as of April 2, 2009, the State of Illinois has received only four notices of schools determining that green cleaning is not economically feasible [out of nearly 900 districts in the state]."

For more green cleaning success stories, check out Breathing Easier: School Districts Make the Switch to Certified Green Cleaning Products, a new report from Regional Asthma Management and Prevention (RAMP).

Greenwashing:

Be Skeptical of 'Greenwashing' Claims

Many cleaners make extravagant claims of being environmentally-friendly, but often this marketing simply doesn't stand up to scrutiny. No regulations exist to require that manufacturers be honest with consumers.

A case in point is Simple Green Concentrated Cleaner/Degreaser/Deodorizer. Simple Green's label advertises "non-toxic" and "biodegradable" as its chief green attributes. It neglects to mention that the principal cleaning ingredient, 2-butoxyethanol, is a possible human carcinogen (EPA 1999), can damage red blood cells (NTP 2000), and is specifically prohibited in green cleaning supplies certified by Green Seal or EcoLogo. Testing reveals that Simple Green emits a host of other air contaminants, including five with well-documented ties to asthma, cancer, hormone disruption, and neurotoxicity - hardly a "non-toxic" product. EWG did not test other products made by the same manufacturer, Sunshine Makers, that are certified green cleaners.

A further greenwashing concern illustrated by Simple Green Concentrated Cleaner/Degreaser/Deodorizer is that of misleading packaging. While directions on the product indicate it should always be diluted, it is packaged with a pump spray top that encourages those not carefully reading directions to use it at full-strength. Typical users thus expose themselves to far more cleaner chemicals by not diluting the product as directed. For this reason, EWG tested this particular product at full-strength.

Product names can also be a source of confusion. JohnsonDiversey makes multiple versions of the glass and general-purpose cleaner Glance – but only Glance NA (Non-Ammoniated) is a certified green product. In EWG's tests, a state-of-the-art air quality laboratory examined both the certified green Glance NA and a conventional version, Glance HC. The conventional product emitted 4 times more contaminants than the green version, including 2-butoxyethanol.

According to U.S. Environmental Protection Agency regulations, disinfectant products cannot make green claims because they contain registered pesticides. Some certified-green cleaning products can be used at higher strengths to disinfect. When used in this more concentrated form, green certification standards no longer apply to these products.

While disinfectants can be a useful part of a green cleaning program, they can be overused. Sometimes disinfectants are incorrectly diluted, leading to solutions that are over-concentrated – particularly when hand mixing methods are used. In other cases, disinfectants are improperly used as general purpose cleaners to save a custodian's time in switching between different products. Germ control is important for the school environment, but indiscriminate use of disinfectants does not provide added protection from bacteria, viruses, and other pathogens, and can expose children and school staff to hazardous chemicals. The Centers for Disease Control and Prevention (CDC) and the California Department of Public Health (CDPH) recommend regularly cleaning and sanitizing or disinfecting all areas and items that are more likely to have frequent hand contact, and immediate cleaning of these areas when visibly soiled (CDC 2009; CDPH 2009), consistent with recommendations outlined by the American Academy of Pediatrics (AAP 2009). However, even with heightened concerns during flu season, neither agency recommends additional disinfection measures beyond those used to keep schools clean.

Air fresheners are an example of cleaning supplies that are unnecessary and potentially harmful. No green certification standards exist for air fresheners. These products are specifically designed to mask odors by contaminating the air with numerous chemicals, exposing nearby people to a host of undisclosed, untested, and potentially toxic substances. Ingredients commonly used to create the fragrances in air fresheners include phthalates, linked to male reproductive system birth defects and hormone disruption (Swan 2005; Main 2006; Huang 2007), and synthetic musks, linked to allergies and hormone disruption (Thune

1988; DeLeo 1992; Schreurs 2004, 2005a, 2005b). Instead of using air fresheners, it is better to identify and clean up or remove the source of any offending odors. Persistent odors can be an indication of inadequate ventilation, mold or mildew, or pests and vermin.

Because marketing claims are unregulated, only certified green products are required to meet comprehensive health and environmental standards. These standards are updated periodically to reflect the latest science on toxic chemicals, ensuring product improvement over time. EWG advises school staff and everyday consumers to look for products certified by Green Seal or EcoLogo when shopping for cleaning supplies for school or home.

Study Methodology

School District Survey

We went straight to the source to determine which cleaning supplies are used in California public schools. We canvassed custodial and operations staff from many of the largest and most diverse school districts in the state, along with smaller districts in high-asthma areas. We asked for information on everything from window cleaners to floor finishes. We collected full or partial lists of cleaners in use, or approved for use, in 13 districts, including Bakersfield City, Fairfield-Suisun Unified, Fresno Unified, Jefferson Unified (Daly City), Los Angeles Unified, Oakland Unified, Sacramento City Unified, San Bernardino City Unified, San Francisco Unified, San Jose Unified, Stockton Unified, Visalia Unified, and West Contra Costa County Unified. Many school districts refused to provide this information without assurance that we would not reveal publicly which cleaning supplies they use.

EWG staff also reviewed the limited data on chemical composition and health and safety information available in the Material Safety Data Sheet (MSDS) that the manufacturers provide for each product.

Air Contamination Tests of Individual Cleaning Products

We conducted in-depth air quality testing of 21 representative cleaners used in schools in California to identify air contaminants emitted during product use. We selected the 21 products tested based on criteria that included a) product type; b) high volume and frequency of use; c) use in multiple districts; d) widely available brands; e) ingredients of concern listed in MSDS; f) total volatile organic compound data listed in MSDS; g) pine- or citrus-based cleaners. We tested multi-purpose cleaners, floor cleaners, glass cleaners, bathroom cleaners, disinfectants, floor treatments, a floor stripper, a graffiti remover, a metal cleaner, and an air freshener.

Tests were conducted by Air Quality Sciences (AQS, Marietta, GA; www.aqs.com), an ISO 17025-accredited, 9001:2000-registered, and AIHA-accredited indoor air quality testing and research company. Cleaning products were tested in small stainless steel environmental chambers with volumes of $0.09 \pm 0.005 m^3$. Chambers designed and built by AQS meet construction specifications and performance requirements established by U.S. EPA guidelines and ASTM Standard D 5116-06, "Standard Guide for Small Scale Chamber Determination of Organic Emissions from Indoor Materials/Products," and ASTM Standard D 6670-01, "Standard Practice for Full-Scale Chamber Determination of VOCs from Indoor Materials/Products."

Application levels employed were consistent with those specified in the recent California Air Resources Board report on air quality concerns associated with cleaning supplies (Nazaroff 2006). For cleaners applied using spray bottles, approximately 11 g/m^2 of product was tested; for liquid cleaners applied via pouring rather than spraying action, approximately 17 g/m^2 of product was tested; for floor products, approximately 27 g/m^2 of product was tested; for the air freshener, a single spray of product was tested; for the powder cleanser, 176 g/m^2 of product was applied to the pre-wetted surface.

Products requiring dilution were diluted to levels appropriate for "medium" or "normal" cleaning strength, following manufacturers' instructions. An exception to this protocol was made for Simple Green, a product that is packaged in a spray bottle and is therefore commonly used at full-strength, rather than in the diluted form as suggested by the manufacturer. Another exception was made for Alpha HP Multi-Surface Cleaner: this product was diluted to be used as a non-certified disinfectant (dilution 1:64), rather than as a Green Seal-certified multi-purpose cleaner (dilution up to 1:256). Air contaminants produced by more dilute cleaning solutions may be estimated by dividing levels measured by the dilution ratio, then eliminating those chemicals with values below the detection limit. This method was used to estimate contaminants that would be released by Alpha HP at the Green Seal-certified, cleaner dilution level.

The environmental chambers used for these measurements were glove boxes, sealed chambers

with attached gloves that allow for manipulation of the cleaning products and materials within. Use of glove boxes allowed simulation of the mechanical action of cleaning. Spraying and scrubbing can result in increased volatilization of chemicals, improving detection of those chemicals contaminating the air during and after real-world cleaning activity. All products were applied to the model surface in a manner consistent with manufacturers' directions and actual school use information. Products remained untouched on the surface for one minute, or longer when dictated by manufacturer instructions. Paper towels were used to simulate scrubbing, wiping, and mopping action.

During testing, supply air to the chamber was stripped of volatile compounds, particles, and other contaminants, so that background levels present in the empty chamber were below strict limits (less than 10 micrograms/m^3 for total volatile compounds or total particles, and less than two micrograms/m^3 formaldehyde or any individual compound). Standard test conditions were 23 ^oC, 50 percent relative humidity, and one air change per hour.

For each product, three sets of samples were collected in the first hour after application in the chamber to identify which volatile compounds were released. The period during the collection of the first set of samples included both the sitting phase, the period of mechanical action associated with each product, and the 10 minutes following. The second set of samples was collected between 10 and 30 minutes following product application, and the third set was collected between 30 minutes and one hour after application. In contrast, to characterize chlorine and ammonia release, a single set of samples was collected over the full first hour after application. Measurements for all contaminants were used only to identify compounds, rather than to provide information on the specific levels of released chemicals.

Analysis of Aldehydes – Emissions of selected aldehydes including formaldehyde were measured following ASTM D 5197 and U.S. EPA IP-6A measurement by high performance liquid chromatography (HPLC). Solid sorbent cartridges with 2,4-dinitrophenylhydrazine (DNPH) were used to collect formaldehyde and other low molecular weight carbonyl compounds in chamber air. The DNPH reagent in the cartridge reacted with collected carbonyl compounds to form the stable hydrazone derivatives retained by the cartridges. These derivatives were then eluted using HPLC-grade acetonitrile. The sample was analyzed using reverse-phase HPLC liquid chromatography with UV detection. The absorbances of the derivatives were measured at 360 nm wavelength. The mass responses of the resulting peaks were determined using multi-point calibration curves prepared from standard solutions of the hydrazone derivatives. This method does not detect contaminant levels below five micrograms/m^3. A level of certainty associated with the identity of each compound is provided. All compounds were identified with a certainty of at least 80 percent; some compounds were identified with a certainty equal to or greater than 99 percent.

Analysis of Volatile Organic Compounds (VOCs) – Measurements of volatile compounds were made using gas chromatography with mass spectroscopic detection (GC/MS). Chamber air was collected onto a solid sorbent, which was then thermally desorbed into the GC/MS. The sorbent collection technique, separation, and detection analysis methodology follows U.S. EPA Method IP-1B and ASTM D 6196 and is generally applicable to C6 – C16 organic chemicals with boiling points ranging from 35 ^oC to 250 ^oC. This method does not detect contaminant levels below five micrograms/m^3. A level of certainty associated with the identity of each compound is provided.

Analysis of Ammonia & Chlorine – Measurements of ammonia and chlorine were made by Bureau Veritas North America, Inc. (Novi, MI). Ammonia was analyzed based on NIOSH S-347, using a 12.5 L air collection volume. This method does not detect contaminant levels below 1.1 mg/m^3 (or 1.6 parts per million). Chlorine was analyzed based on NIOSH 6011, using an 18.7 L air collection volume. This method does not detect contaminant levels below 0.53 mg/m^3 (or 0.18 parts per million).

Quality Assurance & Quality Control – AQS is an ISO 9001 registered and ISO 17025 accredited testing firm with defined and executed internal and

third party verification programs encompassing emissions test methods and low-level pollutant measurements. To assure low levels of background contamination, supply air purity is monitored on a weekly basis, using identical methodology to the chamber testing. Precision of measurements of volatile compounds and aldehydes is assessed via relative standard deviation from duplicate samples. Accuracy of volatile compound measurements is based on the recovery of toluene mass spiked onto absorbent material. Accuracy of aldehyde measurements is based on Workplace Analysis Proficiency Scheme formaldehyde proficiency test results.

For each product tested, EWG has provided a list of the air contaminants detected in the Cleaning Supplies database, along with information on health concerns associated with these chemicals and with the limited number of ingredients mentioned by product manufacturers.

Air Contaminants Measured During Classroom Cleaning

For a complete, quantitative assessment of the contaminants released during typical classroom cleaning activities, a room-sized environmental chamber was fitted with classroom appliances and cleaned using three product types: a floor cleaner, a window cleaner, and a general-purpose cleaner for desks, whiteboards, and shelves. The classroom was cleaned twice – first with conventional cleaning products, and then with certified green cleaning products – allowing assessment of the relative amounts of pollution produced by conventional vs. green cleaning.

Product Type:	Conventional Cleaning:	Green Cleaning:
Floor Cleaner	Twister (Champion Chemical)	Marauder (Buckeye International)
Window Cleaner	21 Glass Concentrate (Waxie)	Glance Non-Ammoniated Glass & Multi-Purpose Cleaner (JohnsonDiversey)
General-Purpose Cleaner	Simple Green (Sunshine Makers)	Alpha HP Multi-Surface Cleaner (JohnsonDiversey)

As the environmental chamber was smaller than a standard classroom, the amounts of floor, windows, desks, whiteboards, and shelves were scaled appropriately:

Measurement:	Standard Classroom:	Environmental Chamber:
Room Volume (m^3)	231	31.2
Floor Area (m^2)	89.2	12.05
Window Area (m^2)	4.46	>0.60
Desk Top Area (m^2)	12.3	1.66
Whiteboard Area (m^2)	9.9	1.34
Bookcase/Shelving Area (m^2)	7.81	1.05

Cleaning of the model classroom environment was approached with great care. The process began when a laboratory technician, wearing a Tyvek suit, latex gloves, and eye protection, entered the chamber with all cleaning supplies, including cleaning products, rope mops for the floors, and paper towels for the windows and other surfaces. The chamber door was immediately closed and the cleaning phase commenced.

Cleaning activities were designed to simulate typical or "medium soil" cleaning requirements, using product application levels consistent with recent research by the California Air Resources Board, as described above (Nazaroff 2006). This involved leaving products undisturbed on surfaces for brief time periods in some cases. The number of spray applications was optimized to achieve the desired product applications. Specific cleaning protocols used are detailed below.

Window Cleaning: six sprays of the product were applied to a 0.60 m^2 piece of glass representing a window surface. The surface was left wet for one minute, then wiped with paper towels until clean.

Whiteboard Cleaning: 14 sprays of the product were applied to a 1.34 m^2 section of powder-coated aluminum representing a whiteboard surface. The surface was left wet for one minute, then wiped with paper towels until clean.

Bookcase Cleaning: 11 sprays of the product were applied to a 1.05 m^2 section of powder-coated cold rolled steel representing a shelving surface. The surface was left wet for one minute, then wiped with paper towels until clean.

Desk Top Cleaning: 18 sprays of the product were applied to a 12.3 m^2 section of powder-coated cold rolled steel representing a desk top area. The surface was left wet for one minute, then wiped with paper towels until clean.

Floor Cleaning: The 12.05 m^2 area of stainless steel flooring was separated into quadrants, and each quadrant was cleaned. A rope mop was submerged into the cleaning solution, tilted to drain off the excess solution, and spread over a quadrant using six mop strokes (back and forth). The mop was wrung and then used to soak up the remaining solution in 24 half-strokes with additional wringing after each four to six strokes. Once all four quadrants were cleaned, a final mopping of the floor was performed using a wrung mop to complete the dry-mopping phase.

Once the cleaning protocol was completed, the technician exited the chamber, removing all supplies. Testing resumed according to the sampling test protocol detailed below.

Quantitative measurements of aldehydes and volatile organic compounds were made covering five specific time periods, beginning with the cleaning procedure and extending for four subsequent hours:

- During cleaning (~38 minutes), and for 10 minutes following cleaning
- From 10 minutes to 30 minutes following cleaning
- From 30 minutes to one hour following cleaning
- During the second hour following cleaning
- During the fourth hour following cleaning

Quantitative measurements of ammonia and chlorine were made using air collected during cleaning and for an hour following cleaning, as well as for the second hour following cleaning.

Background air samples were collected prior to application of the cleaners, but with the test materials (mop, bucket, and paper towels) in the chamber, to verify that cleaning materials were not responsible for the air contaminants detected.

Measurements of aldehydes, volatile organic compounds, ammonia, and chlorine proceeded as outlined above. However, in this case aldehyde measurements were quantifiable at or above a level of 0.1 micrograms based on a standard air collection volume of 45 L. Volatile organic compound measurements were quantifiable at a level at or above of 0.04 micrograms based on a standard air collection volume of 18 L. Detailed results are presented in an appendix.

Contaminants' Health Effects

EWG assessed health effects of air contaminants from definitive government, industry and academic sources, consistent with practices established under current green certification

standards.

Air contaminants were linked to health effects in a manner largely consistent with current green certification standards. The Association of Occupational and Environmental Clinics (AOEC) has established a well-respected list of asthmagens, chemicals known to cause the development of asthma in previously healthy individuals (AOEC 2009). Green Seal-certified products must not contain ingredients identified as sensitizer-induced asthmagens by AOEC (Green Seal 2008). Those asthmagens not specifically identified as sensitizers by AOEC are not specifically excluded by this criterion.

Chemicals identified by EWG as linked to cancer include those listed as known, probable, reasonably anticipated, or possible human carcinogens by the International Agency for Research on Cancer (IARC; Groups 1, 2A, and 2B), National Toxicology Program (Groups 1 and 2), EPA Integrated Risk Information System (weight-of-evidence classifications A, B1, B2, C, carcinogenic, likely to be carcinogenic, and suggestive evidence of carcinogenicity or carcinogen potential), or by Occupational Safety and Health Administration (as carcinogens under 29 CFR 1910.1003(a)(1)). Green Seal-certified products must not contain these carcinogenic ingredients, or ingredients known to produce or release these compounds (Green Seal 2008). EcoLogo-certified products cannot be formulated or manufactured with any carcinogens listed by IARC in Groups 1, 2A, or 2B (EcoLogo 2008).

Reproductive toxins identified in this report are those chemicals listed as such (including developmental, female, and male toxins) by the State of California under the Safe Drinking Water and Toxic Enforcement Act of 1986 (California Code of Regulations, Title 22, Division 2, Subdivision 1, Chapter 3, Sections 1200, et. seq., also known as Proposition 65). Green Seal-certified products must not contain these reproductive toxins, or ingredients known to produce or release these compounds (Green Seal 2008).

Hormone disrupting chemicals identified in this report are those chemicals listed as priorities for research on these properties by the European Union in Appendix 9 of Towards the Establishment of a Priority List of Substances for Further Evaluation of Their Role in Endocrine Disruption (European Commission DG ENV 2000). EcoLogo-certified products cannot be formulated or manufactured with any potential hormone disruptors listed in Appendix 1 of this report, which lacks a handful of chemicals listed in Appendix 9 (EcoLogo 2008).

Neurotoxins identified in this report are those chemicals known to be neurotoxic to humans in a recent review by Grandjean and Landrigan (2006).

A variety of other health and toxicity concerns tied to cleaner chemicals are drawn from EWG's Skin Deep database. Originally created to highlight concerns associated with ingredients in personal care products, Skin Deep is a core database of chemical hazards, regulatory status, and study availability created by pooling the data of more than 50 databases and sources from government agencies, industry panels, academic institutions, or other credible bodies (EWG 2009). Chemicals in the database receive an overall toxicity score from 0 to 10, with a score of 0 signifying few known health concerns, and 10 signifying many known health concerns.

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