

Carpet and High Performance Schools

CRI Technical Services

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Schools Need Carpet

Schools are special environments that exist for the purpose of teaching and learning. Today there is a deep concern over a lack of educational performance in our public schools. Coupled with that concern for improved learning is the reality of widespread deterioration of public school facilities. Increasingly communities recognize that when inviting environmental conditions do not exist in a school environment, there are numerous of complaints related to environmental quality and health and a increasingly lack of interest in teaching or learning.

Carpet can help create school environments where teachers want to teach and students want to learn.

In the United States there are about 120,000 schools providing for the educational needs of approximately 54 million students. Approximately 85,000 of these are public schools. On average, students receive about 20% of their environmental exposure in schools. Unfortunately, about 50% of public school facilities throughout the United States have environmental problems caused by water intrusion, broken HVAC systems, and ineffective or non-existent cleaning programs. Faced with the fact that in the next five years approximately 50% of all schools must undergo significant restoration and renovation at a cost of \$100 billion nationally, it is vitally important that the facts about the benefits of carpet in schools be told.

Carpet contributes many features to a healthy high performance learning environment. Some of carpet's enhancing features are general comfort, warmth, noise control, glare reduction, and protection from slips and falls. Because of attributes such as these, the majority of schools have used carpet as a preferred flooring covering for many years now and have operated quite successfully with that flooring. However, for some time there has been a growing perception that carpet cannot be properly maintained in school environments, that it tends to become extraordinarily contaminated, contributes to unhealthy indoor air quality, and should be removed and replaced with hard floors.

The fact is, clean carpet poses no health risk in schools or any other environment. Even so, it has become common place to recommend the removal of carpet from schools thinking that it will somehow clean things up and improve IAQ.

Unfortunately, the misguided restoration policy of replacing carpet with hard floors occurs mostly in public schools with under-funded operating budgets and limited long term accountability for the decision making outcome. Too often the decision to replace carpet with hard floors dodges the issue and responsibility of effective cleaning, transfers pollutants to hard surfaces and indoor air, and is unnecessarily costly to the taxpayer. The incorrect judgment that "carpet does not belong in schools" does not address the real need to keep the school environment clean and dry regardless of flooring type. It is also a disservice to students, teachers, and staff who deserve and need an elevated level of comfort in their

teaching and learning environment with the amenities that carpeting can offer: soft surface on which to stand long hours, warm and energizing colors, glare reduction, and noise control.

No amount of carpet removal will correct roof and window leaks, failed drainage systems, broken HVAC, or ineffective or non-existent cleaning programs. Schools with dirty carpet either do not know how to clean carpet or choose not to operate and maintain the school facility in a adequate manner.

Benefits of Carpet in Schools

Choosing the appropriate floor surface for a school environment need not be a complex issue. Jumping to the conclusion that hard floor surfaces automatically contribute to better indoor air quality is not supported by an existing body of science.

The importance of a healthy school environment in enhancing the learning process is described in many studies. It has long been known that when a school building is in disrepair, teaching and student achievement suffers (Maslow and Mintz.,1956). There is a direct connection between environmental quality, comfort, health and well-being, positive attitudes and behavior, and higher levels of educational performance. The quality of the school environment sends caring or non caring messages. The message shapes attitudes of students, teachers and staff. Attitudes in turn affect teaching and learning behavior. Behavior affects performance. And finally, educational performance is measured in part by test scores and in the long run by the accomplishments of students.

Sadly, in many older and under-funded public schools, students and teachers find themselves in an environment that adversely affects their morale and their health. The school environment does the exact opposite of what it should do and works against the educational process. Far too often public school systems elect to postpone repairs and delay construction of new facilities to divert money during periods of financial austerity.

Studies of high performance schools find that an academically successful school radiates a sense of “well-being”. This sense of “well-being” is the essence of a healthy environment. These schools send a message that someone cares. For school environments to be healthy and effective, there must be a serious, if not passionate desire, accompanied with positive action, to keep the environment sanitary or restore non-performing schools to a constant healthy state. In effect, high performance schools are always well managed.

High performance schools manifest common traits and carpet enhances these traits. For example:

A high performance school is designed to reduce stress. It is comfortable, has a consistent temperature. Carpet by virtue of its design is soft and radiates warmth.

A high performance school seeks and provides adequate space and opportunities for students and teachers to spread out, reflect, interact, exchange information, and examine and test ideas. More often than not carpet provides an auxiliary surface on which teachers and students sit and interact effectively, such as in “carpet time” as part of reading education.

The school strives for student-friendly conditions, throughout the building. The appearance of the school is inviting. Students, teachers, and the local community want it to be there. Carpet colors and patterns are designed to be esthetically pleasing and inviting .

The high performance school has adequate natural lighting and noise control that enhances productivity. Carpet dampens noise, absorbs light and reduces glare.

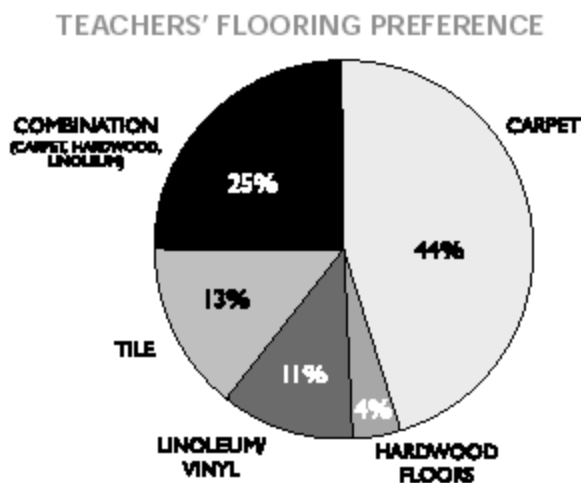
When added up, carpet has attributes and environmental benefits for attracting students and teachers to a productive learning environment that far outweigh any conceivable environmental health risks.

Teachers Know Best

Good teachers are difficult to find and retain. Effective teachers need the support of their administrators and community and should not be denied the teaching conditions they need and deserve to develop highly achieving students. A nationwide study of more than one thousand public school teachers found that teachers believe carpet helps provide the safety, comfort and acoustics that create the “ideal learning environment” for students. The majority of teachers preferred carpet, believed carpet contributed to student attendance, increased individual safety, and had a strong impact on students’ learning and achievement.

In A Nationwide Study, Teachers Prefer Carpet 3 to 1.

In a study of public school teachers, carpet was the teachers’ favorite floor surface for a variety of reasons. The 2001 national study by the Atlanta-based research firm, Beth Schapiro & Associates, surveyed 1,050 public school teachers from across the country. Findings revealed that only 18 percent of respondents gave their classrooms an “A” for design, yet 99 percent believed that school design is important in creating a good learning environment. Of the top four design features teachers believe have a strong impact on student achievement, three—safety, comfort and acoustics—can be addressed by incorporating carpet in classroom décor. In addition, 89 percent of teachers claim that school design is important to teacher retention, and 79 percent believe that school design influences student attendance. A full 92 percent believe that comfortable classroom design has a strong impact on students’ learning and achievement.



Source: National study conducted by Beth Schapiro & Associates for the Carpet and Rug Institute and the International Interior Design Association Foundation

Comfortable Classrooms Produce Better Performing Students

There is a very large percentage of teachers who say classroom design influences students' learning

The majority of teachers surveyed had carpet in their classrooms, and, of that group, more than two-thirds preferred carpet. The majority of respondents also cited increased safety from falls, increased comfort underfoot, and better noise absorption. Nearly three-quarters of teachers said they prefer carpet alone or a combination of carpet and hard-surface flooring in schools.

TOP FIVE CLASSROOM DESIGN ELEMENTS

1. SAFETY
2. COMFORT
3. LIGHTING
4. ACOUSTICS
5. CLIMATE CONTROL

An important observation: Carpet contributes to each of these.

Carpet Contributes to an Effective Learning Environment

According to Gaye Elliott, design associate at the nation's largest school design firm, Fanning & Howey Associates, "Carpet can create a quiet environment with good acoustics, which helps students concentrate." ("Open Up Schools...Creature Comforts Can Aid Learning," USA Today, March 22, 2001)

Light and Noise Control

Natural lighting, glare reduction, and noise control are environmental conditions that have been positively correlated with good educational performance as measured by test scores.

Carpet floor coverings are very instrumental in making classrooms work when noise control is critical. In a recent case study of the Charles Young School, student reading skills have greatly improved because of open classes and flexibility of teaching associated with total usable space that includes the floors. An ability to communicate between student and teacher is possible only with good sound control. Classrooms at Charles Young have estimated sound levels that range between 58 and 65 db. Normal speech can easily transmit throughout the school building. The use of carpet in the Charles Young School makes satisfactory sound control simple and economical to achieve. Research conducted by the State of California has shown that "without carpet, effective sound control in open space classrooms is virtually impossible to achieve" (School Facilities and Transportation Division, State of California, 1986).

Carpet Provides Comfort Which in Turn Contributes to Positive Attitudes and Enhanced Productivity and Higher Test Scores

A 2002 case study of the restoration of Charles Young Elementary School in Washington, D.C, supports Elliott's assumption. More than 45,000 square feet of carpet were installed as part of the Charles Young restoration project with the goal to create attractive, comfortable, open classrooms free of glare and noise. Among the findings of the study, according to Dr. Michael A. Berry, research professor, University of North Carolina at Chapel Hill, was "the

obvious link between students' environment and educational performance." Standardized test scores in math and reading, both before and after the restoration, bear this out. A dramatic improvement in student performance was noted post-restoration. A full 25 percent of the school's student population improved their test scores from "below basic" to "basic" or higher levels.

A 2002 case study, written by Dr. Berry and published in part in the proceedings of Indoor Air 2002, found the higher test scores attributable in part to the comfortable and inviting environment that included carpet in the decorating mix at the Charles Young School.

Carpet Improves Safety

Next to traffic accidents, falls kill more people indoors than any other accident. Slips, trips and fall are among the most costly and painful.

In 1993 the U.S. Consumer Product Safety Commission reported on falls. 12,000 lives are lost each year as the result of injuries from falls. These accidents are equally distributed between work and home. Persons 65 years and older were the most likely to be fatally injured in a fall. Falls are the leading accidental cause of death for people over the age of 80. Children aged 10 and younger were the second age group most likely to be injured by falls.

In wet conditions, the risk of a slip on hard surfaces is two times greater than on carpet. Hard surfaces are also less forgiving and more likely to result in more severe injury. Yet there has been a trending away from carpet installation in schools, especially in hallways and on stairs where more slip/fall accidents occur. Factor in the inevitable commotion and bustle on rainy school mornings when slick hard surface hallways become accidents waiting to happen.

Carpet is Economical

If schools want to keep costs down, it is critical they do a cost benefit analysis related to flooring. In a time of budget cutbacks and belt-tightening, schools must be extremely dollar-wise when calculating design budgets. Yet the installation of hard-surface flooring and its ensuing high-cost, labor-intensive maintenance, takes a heavy bite out of schools' budgets. Planners must look beyond initial cost when choosing flooring for schools. In the short to medium term, "cheap" floors can quickly become expensive floors. According to Canadian Facility Management & Design (April 2002), "Maintenance is the single most costly element in most floor coverings. Thus, the most important economic consideration is the true life-cycle cost of a floor covering." For example, an installation of hard-surface flooring compared to carpet will result in additional costs of 18% in heavy traffic areas.

Schools must take into account the true lifecycle cost when making a flooring decision. Initial installation is only part of the equation; maintenance costs including labor, materials and equipment quickly add up. As a result, carpet is the more economical choice for cash-strapped school systems. Carpet with a built-in stain resistance offers even greater savings.

LIGHT TO MEDIUM TRAFFIC AREAS	CARPET	Hard Floor
Materials plus installation at 0 year	\$2.33	\$0.89
Carpet removal cost at the 16-year and 32-year periods	\$0.66	
VCT removal cost at the 20-year and 40-year periods		\$1.50
Carpet reinstalled (materials plus installation at 16-year and 32-year periods)	\$4.66	
VCT reinstalled (materials plus installation at 20-year and 40-year periods)		\$1.78
Cost of floor covering system for 40 years	\$7.65	\$4.17
Cost of cleaning and maintenance for 40 years, including labor cleaning supplies, equipment, and equipment maintenance	\$12.71	\$19.62
TOTAL LIFE-CYCLE COST FOR 40 YEARS	\$20.36	\$23.79

HEAVY TRAFFIC AREAS	CARPET	Hard Floor
Materials plus installation at 0 year	\$2.33	\$0.89
Carpet removal cost at the 16-year and 32-year periods	\$0.66	
VCT removal cost at the 20-year and 40-year periods		\$1.50
Carpet reinstalled (materials plus installation at 16-year and 32-year periods)	\$4.66	
VCT reinstalled (materials plus installation at 20-year and 40-year periods)		\$1.78
Cost of floor covering system for 40 years	\$7.65	\$4.17
Cost of cleaning and maintenance for 40 years, including labor cleaning supplies, equipment, and equipment maintenance.	\$23.18	\$32.25
TOTAL LIFE-CYCLE COST FOR 40 YEARS	\$30.83	\$36.42

Carpet and Health Science

Effective environmental management policy, including that of flooring in school facilities, can exist only when it is based on sound science rather than personal opinion. Carpet has been looked at by the health sciences community for over four decades and has never associated new or properly maintained carpet with adverse health effects. The fact is that carpet has been effectively used with no problems in many sensitive environments such as nursing homes, hospitals, and schools for over 40 years.

Recurring reviews of the scientific literature find no evidence that properly maintained carpet poses a risk to public health. Study after study have been unable to link carpet to adverse health effects. In fact, where the air quality was measured, air over carpet was time and again less polluted than air over hard floors. “Carpet holds particles down. It takes 10 times less air movement to lift particles (into the air) off a hard surface than a carpet.”

In 2001, Dr. Michael. Berry wrote a report titled “Assessment of Carpet in Sensitive Environments.” In it he examines the findings from hundreds of studies that looked at the relationship between carpet and IAQ in settings that directly affect the very young, the very old and those who are ill. In his study he finds

“Carpet is a preferred and widely used floor covering associated with minimal complaints. There is approximately 150 billion square feet currently installed in over 100 million buildings. About 1.2 billion square yards of carpet are installed every year. Complaints per square yard of carpet installed are extremely small. Yet there are many claims throughout the media and general public that carpet contributes to unsanitary IEQ. These claims are not supported in the scientific literature. Research to date, some going back over 30 years, consistently shows carpet to be a safe and healthy product.”

Dr. Berry’s findings agree with those of three other IAQ experts’ published findings on the subject: Dr. Steven Spivak (1989), Dr. Jens Korsgaard, (1990) and Dr. Alan E. Luedtke (May 2000), some of which follow:

“It cannot be plausibly argued that textile floor coverings are causing or aggravating allergies.” (Korsgaard)

“It has been shown that removal of wall-to-wall carpeting has no clinical effect on patients who are hypersensitive to house dust mites.” (Ibid)

“(Only) 1% of bulk carpet dust was on the “surface” and available for dermal contact”...(Luedtke)

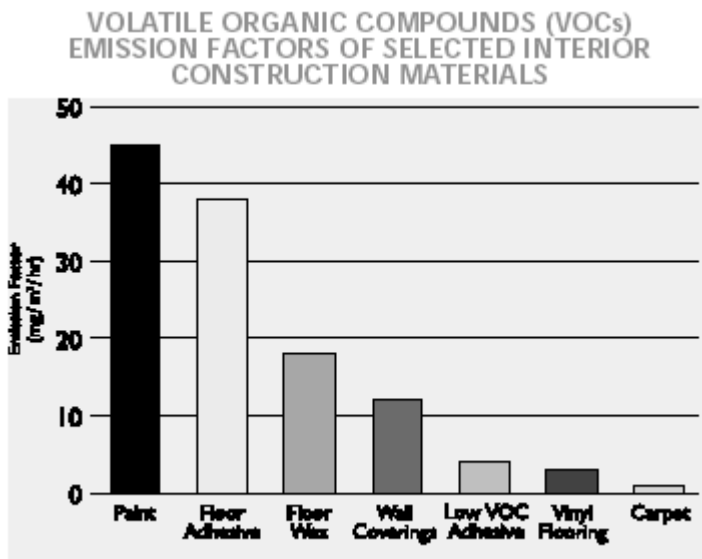
“It did not appear...that particle levels were on average higher over carpet than smooth flooring”. (Ibid)

“There is very little work reported that has linked the textile furnishings and/or their professional cleaning to aspects of indoor air quality (whether positive or negative)” (Spivak)

Carpet and IAQ

Today's energy-efficient sealed buildings have made indoor air quality (IAQ) a major concern. A carpet certified by CRI's Indoor Air Quality testing program, reviewed by EPA for several years now, emits minimal VOCs. On the other hand, other hard surface flooring, especially those coated with floor wax, causes significantly higher spikes in VOC emissions.

In the past 25 years, energy efficiency has been a key element of building design resulting in virtually airtight construction. The creation of the sealed building, however, has led to a new problem: how to maintain satisfactory indoor air quality (IAQ)? Volatile organic compounds (VOCs) are the most significant substances contributing to poor IAQ. These are the off-gases of interior design and maintenance materials.



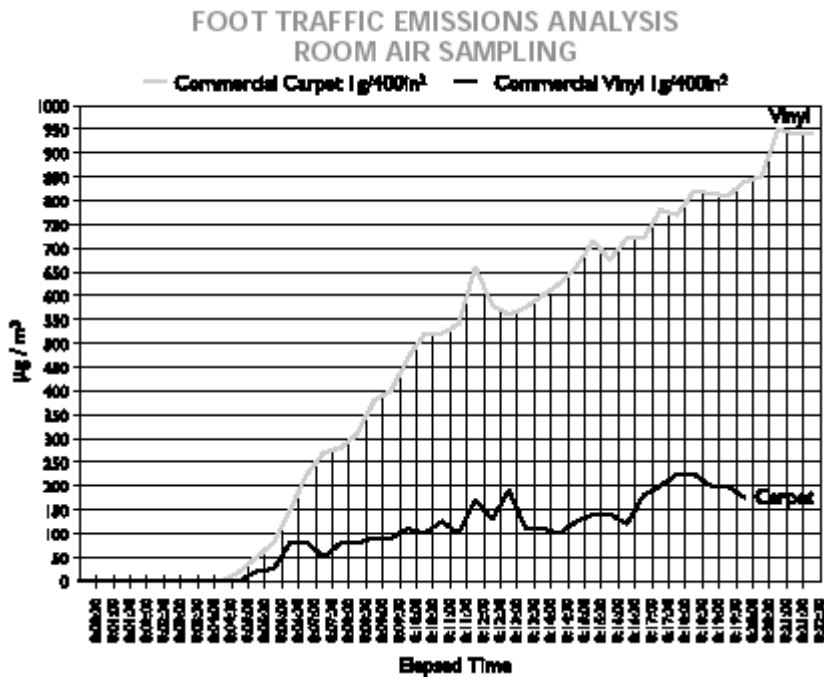
Carpet Traps and Holds Allergens

In a study conducted by Research Triangle Institute and University of North Carolina investigators, during the school year 2000 and 2001, two schools in North Carolina were paired as closely as possible. (Foarde, Berry, 2002) Both were from the same school district and situated in rural locations with very similar outside environmental conditions. Both were first occupied in 1996. The HVAC systems were identical. Both schools appeared well maintained and followed almost identical school district cleaning programs. One school was all tiled with the exception of the administration area and media center. In the other, approximately 70 – 75% of the floor was carpet. This percentage is typical of carpeted schools in the US

The study found that, although the carpet flooring had higher concentrations of biocontaminants than an equal area of tiled flooring, airborne biocontaminants were higher over tiled floors than over carpet. This is not a surprising result, since one of the properties of carpet is that it keeps dirt from being tracked all over and tends to trap and hold materials that would otherwise be resuspended into the breathing zone.

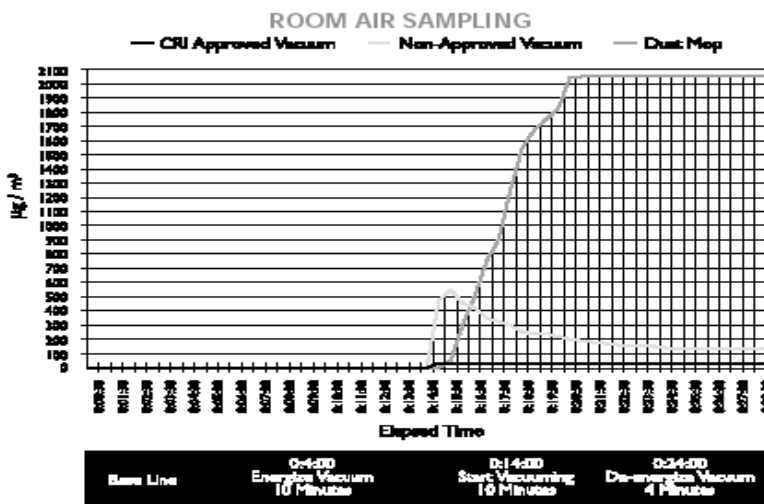
Carpet industry data supports this research. In April 2002, Professional Testing Laboratory Inc. was commissioned to study the effect foot traffic on both carpet and vinyl flooring had on

air quality. Particulate monitors were positioned five feet above the floor to continuously measure particle counts during and following 16 minutes of foot traffic. The following graph illustrates the enormous difference between emissions from the two surfaces and is a powerful support of the finding that, “carpet holds particles down.”



In a second study, effects on IAQ from Carpet and Rug Institute (CRI) certified vacuums were compared to the effects of non-CRI-certified vacuums. The non-certified vacuums caused particulate matter levels in the air to spike 16 times higher than the CRI green label certified vacuums.

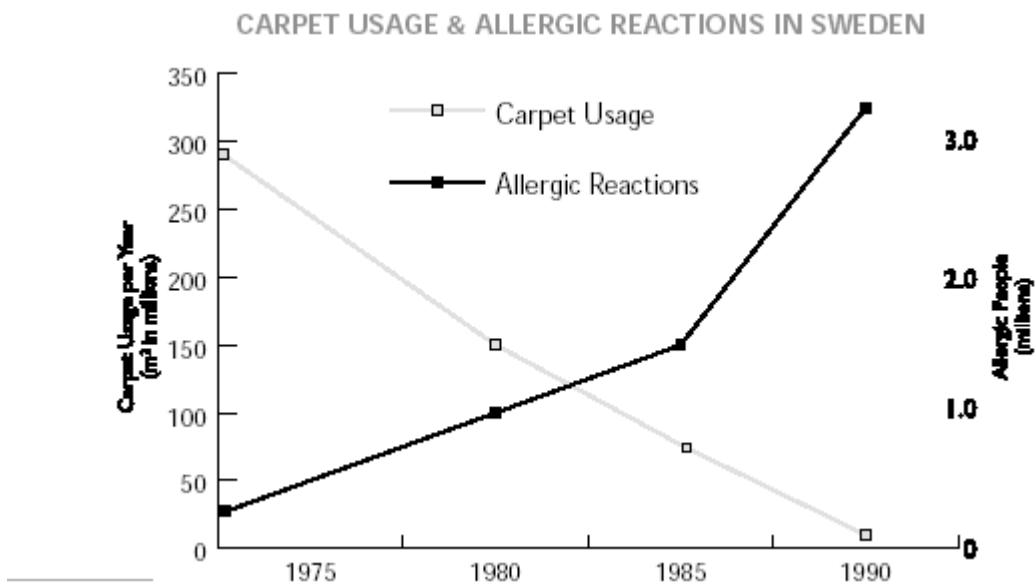
Cleaning hard -surface flooring with a dust mop caused particulate matter levels in the air to spike more than 58 times higher than did the CRI certified vacuums.



(Graph 2)

Carpet and Allergens

Recent research on respirable particulates in carpeted rooms is changing basic assumptions about the link between carpet and allergens. During the seventies, reports from Sweden claimed that carpet was the source of harmful contaminants resulting in allergic reactions. As a result, Swedish consumers and officials severely reduced their use of carpet. By 1992, carpet's share of the floor covering market had dropped to 2 percent. In the early nineties, two professors at the Swedish Institute of Fiber and Polymer Research published their findings that since 1975, occurrences of allergic reactions in the general population had increased drastically. Their conclusion was that the removal and decline of carpet usage did not mean improved conditions for allergic patients.



Carpet and Mold

Concern has grown in recent years about mold and indoor environments, and often carpet is alleged to be source of problems. Yet, in this age of mold anxiety, carpet is not the culprit, it is indoor moisture. It is a fact that, with a film of moisture and a bit of carbon, mold will grow on absolutely any surface—porous or non-porous, hard or soft. Given the proper conditions, mold will grow on textiles, walls, countertops, hard surface floors, carpet, sheet metal, books, furniture, bric-abrac, etc. Moist indoor conditions yield mold growth, period. According to the EPA, when excessive moisture accumulates in buildings or on building materials, mold growth will often occur, particularly if the moisture problem remains undiscovered or unaddressed. It is impossible to eliminate all mold and mold spores in the indoor environment. However, mold growth can be controlled indoors by controlling moisture indoors. (<http://www.epa.gov/iaq/molds/intro.html>)

“Moisture Control is the Key to Mold Control.” While mold is ever present and an essential part of nature’s decomposition process, excess mold growth indoors can be hazardous to human health as a contact irritant or an airborne allergen. Fortunately, schools can take basic steps to remediate and prevent mold growth by keeping indoor environments clean and relatively dry. In recent testimony at a public hearing on “Toxic Mold” sponsored by the New York State Senate in May 2002, Dr. Michael A. Berry addressed this issue: “When the mold

problem is examined closely and realistically, we find that traditional practices such as public health and building codes for clean and water proofed housing...go a long way to correct and prevent mold conditions and potential adverse human response.”

Wherever water and carbon are present, mold will grow. When indoor conditions are mismanaged, mold may be found on any and all surfaces—porous or non-porous, hard or soft. Thus carpet is not the culprit in the battle to stop indoor mold. The most important step schools can take to prevent indoor mold growth is to follow standard practices for maintaining clean, waterproofed buildings. When mold is discovered in schools, the problem can be managed with thorough cleaning of all affected surfaces and proper temperature and humidity maintenance.

It is especially important that cash-strapped school systems get the facts about mold and observe some simple guidelines to prevent and remediate mold growth indoors. Schools must take preemptive measures to manage mold spore levels by keeping indoor environments clean and dry, thus avoiding costly “mold remediation” expenses. Mold is an indication of mismanagement. Addressing just a symptom in the form of mold removal does not solve the real problem which is water damage and the presence of nutrients in the form of dirt or debris. Unfortunately, the burgeoning “mold remediation” industry has responded with costly and often alarming indoor mold removal procedures that go above and beyond what is necessary. Mold assessment and remediation as frequently practiced and sold is overly expensive in relation to the risk reduction it claims to provide. The Centers for Disease Control, USEPA, the Minnesota Department of Health, and New York City have provided sound public health guidance in the correction of indoor mold problem. This guidance is far more reasonable and effective than scientifically unsupported, “politically correct,” actions such as: unnecessary and inappropriate biological sampling; the routine removal of carpet which, when clean, cannot support mold growth; air stripping in lieu of common vacuuming; and the often intentionally dramatic and anxiety promoting full “moon suit” protection of mold removal technicians in cases where that level of personal protection is not warranted.

Studies show that indoor mold growth in mismanaged environments can be successfully corrected with thorough cleaning and corrected indoor humidity. For example, a 1999 study of the impact of soiled carpet on the indoor environment by Air Quality Sciences of Atlanta examined the role of environmental conditions on the potential for biocontaminant re-growth following cleaning. In this study, poorly maintained carpet from a high humidity/high temperature environment was cleaned and placed into a normal environment with humidity less than 65%. No mold regrowth was noted. After cleaning, test results from the previously contaminated carpet were comparable to those of a clean control carpet in terms of biocontaminants in the carpet and airborne particles. (“Carpet Cleaning and Acceptable Indoor Air Quality: A General Review of Carpet Cleaning Effectiveness,” Air Quality Sciences, Inc., June 1999)

In another recent study, mold growth on carpet, VCT, ceiling tiles, and drywall was studied in four phases of highly controlled, elevated temperature and humidity exposures (Berry, 2002). Mold was found not to grow at a exposures level consisting of a temperature of 80° F and relative humidity of 65% on any of the clean and dirty test materials. This is fully consistent with findings reported in the scientific literature. Visible mold was found only after water was applied to test products. Mold growth occurred only in and on the dirt on carpet and

VCT and naturally organic materials such as bare wood. Mold did not grow on clean nylon in any of the eight carpet product test chambers.

The key to sustained mold grow is dirt or organic nutrient and elevated moisture content in materials. Dirt in carpet is hygroscopic and absorbs moisture. Dirt spots on carpet were found to have nearly 10-15% higher moisture levels than clean portions of the nylon carpet. Mold was found to grow only on the dirty portion of the carpet and VCT. Research suggests that the absence of an organic nutrient even in the presence of moisture makes mold growth unlikely.

Mold spore is ubiquitous and are naturally deposited on all surfaces. The research demonstrated that vacuuming carpet surfaces is highly effective in reducing and managing the levels of mold spore. The research also reinforced the suggestion that even at a constant elevated temperature of 80° F and 80% relative humidity for a period of two months, clean carpet does not have a propensity to support mold growth.

It is a fact that mold will grow anywhere. The only way to stop it indoors is to maintain clean, dry indoor environments. Clean synthetic carpet does not support mold growth even at elevated humidity levels. The obvious solution for effective mold management is to keep all materials dry or at least clean.

The Benefits of Effective Cleaning and Carpet Maintenance

Cleaning does much more than just making carpet look good. In fact, clean carpet is often an indication of an effective cleaning program, which should be part of every school regardless of flooring.

Previous studies have shown that cleaning, maintenance and restoration, when consistently implemented, are cost effective and can lead to measurable environmental improvements. For example, an EPA-sponsored study, "The Total Building Cleaning Effectiveness Study," in collaboration with the professional cleaning industry, clearly demonstrated that an organized cleaning program contributes to reductions in particles, volatile organic compounds (VOCs), and biological pollutants in excess of 50-90%.

A year-long field study to characterize the indoor environment of a building and to assess the effects of cleaning on the indoor environment (Franke et al., 1997). The Frank Porter Graham Child Development Center houses offices, laboratories and a day care center. During the first half of the year, the building was maintained and cleaned as normal while baseline measurements of chemicals, particles and biologicals were taken. Then there was a thorough cleaning of the building, cleaning staff training and replacement of equipment and cleaning products. As part of the study, an advisory board with members from the cleaning industry was established. This board provided information on effective industry practices.

The table shows results of the study for particles, chemicals and biologicals alone with practices believed by investigators to contributed to improvements.

Table
Yearlong Study of Frank Porter Graham Child Development Center
University of North Carolina at Chapel Hill

Air Pollutant Category (Building Means)	Routine Housekeeping (5 Months)	Improved Housekeeping (7 Months)	% Change	Most Probable Contribution to Improved Air Quality
Dust				
Airborne mass (ug/m³)	12 (3-31)	6 (1-13)	-50%	- Efficient Vacuum Cleaners and Bags
Carpet mass(g/m ²)	1.8 (0.1-11.6)	2.3 (0.2-9.9)	28%	- Walk-off Mats
Laser particle count (10 ⁶ Particles/m ³) >0.5 um	1.3 (0.28-3.8)	1.4 (0.44-3.6)	8%	- Damp Dust Cloths
				- Frequent Vacuuming and Dusting
				- Deep Cleaning of Entire Building
				- Dust Control on Hard Surfaces
Total VOC (ug/m ³)	324 (88-530) (3 months)	166 (29-309)	-49%	- Cleaning Chemicals with Less VOC
				- Extraction from carpets
				- Balanced Ventilation System
Biopollutants				
Airborne Bacteria (CFU/m ³)	395(71-855)	237 (34-868)	-40%	- Rapid use of Disinfectants After Accidents
Airborne Fungi (CFU/m³)	127(22-406)	50 (2-219)	-61%	- Control of Food and Perishables
Carpet Dust Bacteria (100,000 CFU/g)	204 (1-2060)	32 (1-230)	-84%	- New Extraction Equipment
Carpet Dust Fungi (10,000 CFU/g)	15 (0.2-42)	9 (1-24)	-40%	- Hot Water Extraction of Carpets
				- Moisture Control
				- Removal of Contaminated Sources (Wall, Rotten tree stump)
				- Walk-off Mats

Maintenance Cost

A 1990 study by the Building Office Managers Association (BOMA) compared cleaning rates of carpet versus hard-surface floors. This work was subsequently updated by Jeff Bishop a nationally recognized expert in cleaning and restoration science. As indicated in the studies and analysis, hard surface floors required two and a half times more cleaning time than carpet on an annual basis. Cleaning supplies were about seven times more expensive for vinyl floors than for carpeted floors.

Flooring Maintenance Costs

Light to Medium Traffic Areas

CARPET	FREQUENCY PER SY	MIN/1000SF	SY TOTAL MIN/1000SF	SY \$/SF
Vacuuming	65	13	845	\$0.120
Spot Removal	180	8	1440	\$0.204
Deep Cleaning	2	75	150	\$0.022
Chemical Costs				\$0.007
TOTAL			2435	\$0.353
VCT	FREQUENCY PER SY	MIN/1000SF	SY TOTAL MIN/1000SF	SY \$/SF
Dust Mopping	65	9	585	\$0.083
Spot Removal	180	6	1080	\$0.153
Wet Mopping	72	24	1728	\$0.245
Spray Burnishing	9	15	135	\$0.021
Scrub Cleaning	2	6	12	\$0.002
Strip/Finish	1	76	76	\$0.010
Chemical Costs				\$0.031
TOTAL			3616	\$0.545

Heavy Traffic Areas

CARPET	FREQUENCY PER SY	MIN/1000SF	SY TOTAL MIN/1000SF	SY \$/SF
Vacuuming	180	13	2340	\$0.332
Spot Removal	245	8	1960	\$0.278
Deep Cleaning	2	90	180	\$0.026
Chemical Costs				\$0.008
TOTAL			4480	\$0.644
VCT	FREQUENCY PER SY	MIN/1000SF	SY TOTAL MIN/1000SF	SY \$/SF
Dust Mopping	180	9	1620	\$0.230
Spot Removal	180	6	1470	\$0.208
Wet Mopping	108	24	2592	\$0.367
Spray Burnishing	18	15	270	\$0.038
Scrub Cleaning	2	6	12	\$0.002
Strip/Finish	1	76	76	\$0.010
Chemical Costs				\$0.041
TOTAL			3616	\$0.896

The analysis is based on ISSA (International Sanitary Supply Association) cleaning rates. The analysis assumes a school schedule of 36 weeks and labor cost rates of \$8.50 per hour.

Environmental Impacts of Floor Cleaning

In 1991 a field study on carpet cleaning was sponsored by EPA in Denver, Colorado. (Cole and Foarde, 1992) Carpet cleaning is an area where both the cleaning products used and the procedure followed can affect the indoor environment. In the study, six carpet cleaning methods were used in residences and a school: hot water extraction, shampoo, bonnet (dry), dry foam, and two types of absorbent compounds. As each method was used on carpets, measurements were made of total volatile organic compounds (TVOCs), respirable particles, and biopollutants. In general, it was found that the pollutant levels before and during carpet cleaning were related to the lack of previous cleaning. There was negligible contribution from the carpet cleaning itself.

The VOCs emitted after routine cleaning of carpet are minimal, especially in comparison to routine cleaning of VCT and other hard-surface flooring. In general, carpet requires few chemicals for cleaning and upkeep. On the other hand, the chemicals used to clean, strip and polish hard surface flooring can create large, "VOC spikes which may be circulated throughout the building and which may partially absorb onto other materials and surfaces to be slowly released into the indoor air at a later time." ("When Clean Is Not Green," *Canadian Facility Management & Design*, 4/02) In addition, the chemical waste water and disposal requirements with hard floor maintenance are very large compared to carpet. Chemical waste water is a growing concern in environmentally conscious communities and school districts around the country.

Summary

Carpet is an excellent choice for school settings.

Carpet gives schools the comfortable, caring feel that leads to better concentration, better performance, better attendance rates, retention of teachers, and the potential for higher test scores.

The life-cycle costs of installing and maintaining carpet are more economical than those of hard surface flooring.

Carpet tends to hold particles out of the air and can enhance IAQ.

The wholesale removal of carpet in educational settings, based on health concerns, is unwarranted and not based on good science

Properly maintained carpet improves school IAQ. Clean carpet does not increase particulate density in the air.. In fact, carpet actually holds allergens at bay by preventing their release into the air in heavily trafficked areas..

For more in-depth information on this subject including copies of the original research studies and articles on which this work is based, visit <http://www.carpet-rug.com/>.

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