What is a Green and Healthy School

Green Schools National Network
A Green School enhances student health and learning while conserving natural resources and empowering students to develop sustainable behaviors, enabling them to become the stewards of the future.

The Collaborative for High Performance Schools (CHPS)
We want all schools to be: Healthy, Comfortable, Energy Efficient, Material Efficient, Easy to Maintain and Operate, Commissioned, Environmentally Responsive Site, A Building That Teaches, Safe and Secure, Community Resource, Stimulating Architecture, and Adaptable to Changing Needs.

The U.S. Green Building Council
Green schools are healthier for students and teachers, better for the environment, and cost less to operate and maintain.

The Environmental Protection Agency (Tools for Schools)
Green schools promote a healthy learning environment to reduce absenteeism, improve test scores and enhance student and staff productivity.

U.S. Department of Education's Green Ribbon Schools
Green schools can help children build real-world skill sets, cut school costs and provide healthy learning environments.

Costs for Student Absences

12% of U.S. School Children

are chronically absent and

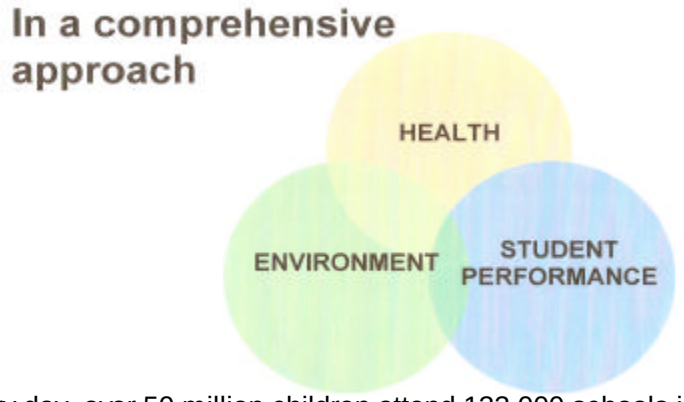
miss 1 out of every 10 school days*

One missed student day costs local school district in state aid ▼ $32

State wide ADA in 2009-2010	95.5%
Keller ISD ADA	97.0%
Boerne ISD ADA	96.0%
North East ISD ADA	96.1%

* TIME Magazine September 17, 2012 issue

LEED & CHPS Talking Points



Every day, over 50 million children attend 133,000 schools in the United States and nearly seven million teachers and staff. More than 20% of America's population that spends about six hours a day in a school building.

"Who's in Charge of Children's Environmental Health at School?"

NEW SOLUTIONS: A Journal of Environmental and Occupational Health Policy Issue: Volume 20, Number 1 / 2010

Who Is In Charge of Children's Environmental Health at School?

http://www.healthyschools.org/documents/WhosInCharge.pdf

New London TX School Explosion 75th Anniversary March 18, 2012

- About 300 students and staff died due to natural gas explosion in a school
- Gas leaked from improper tap connection to an oil field pipeline to get free fuel
- Natural gas did not have an odorant at this time
- Health concerns and complaints related to the gas were ignored

Sources: www.healthy-kids.info

http://www.newlondonschool.org/Cenotaph.htm

Texas Engineering Practice Act
OCCUPATIONS CODE

Title 6 Subtitle A

Chapter 1001: ENGINEERS

Title 6 Subtitle B

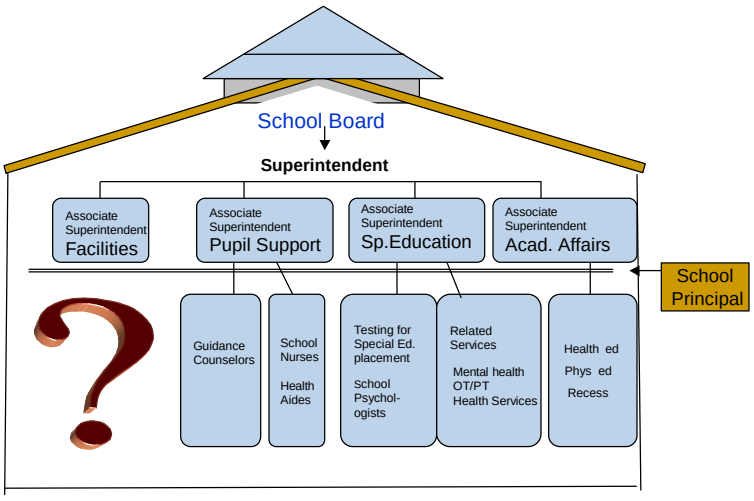
Chapter 1051: ARCHITECTS

Title 6 Subtitle C

Chapter 1071: SURVEYORS

http://www.statutes.legis.state.tx.us/?link=OC

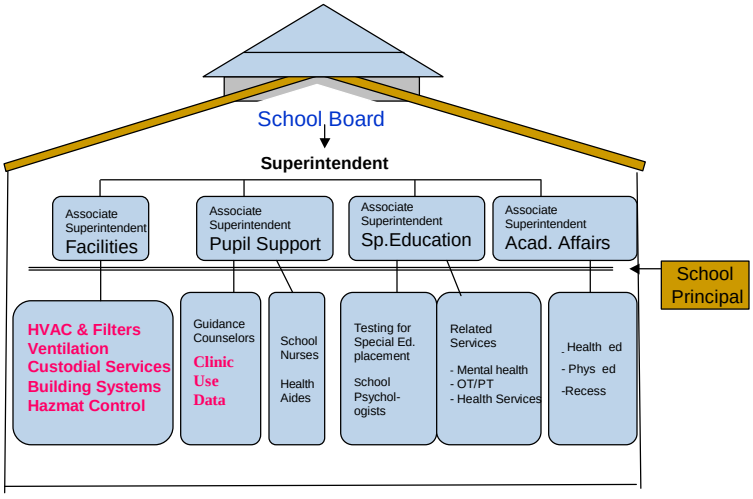
Typical School Health Services & Prevention Program



Julia Graham Lear, PhD, Director Center for Health & Health Care in Schools, School of Public Health & Health Services, George Washington University
Children's Health and Children's Schools: A Perfect Match; A Challenging Fit, Colorado Health Forum August 1, 2009

The Center for Health and Health Care in Schools
www.healthinschools.org

Inclusive School Health Services & Prevention Program



Total Environmental Health and Health Care in Schools
Includes Facilities that Assure Healthy Buildings

EPA List Of Environmental Concerns

Asbestos
Asthma and Asthma Triggers
Buses and Vehicle Idling
Carbon Monoxide
Chemical Management
Drinking Water
Educational, Art and Science Supplies
Extreme Heat and Outdoor Air Events
Indoor Air Quality, Ventilation and VOC's
Lead and Mercury
Mold and Moisture Control
PCBs in Caulk and Fluorescent Light Ballasts
Pesticides and Pest Management
Radon and UV Radiation

State K-12 School Environmental Health Program Guidelines

http://chej.org/2012/08/hiddenhazardsrelease/

Source:http://www.epa.gov/region8/humanhealth/children/SensibleSteps.pdf

Sensible Steps to Healthier School Environments - July 2012

The Alphabet of Green and Healthy Schools

The 3 R's of a Great Education

The 3 W's of High School Achievement

The 3 P's of Environmental Health

The 3 I's of Classroom Indoor Air Quality

The 3 M's of School Building Health

The A, B, C, & D Factors

The 3 R's of a Great Education

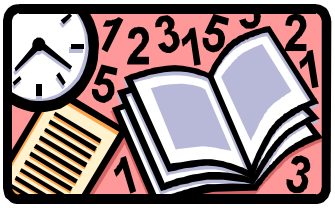
Reading

ŕiteing

ŕithmetic

The 3 W's of High School Achievement

Who



What

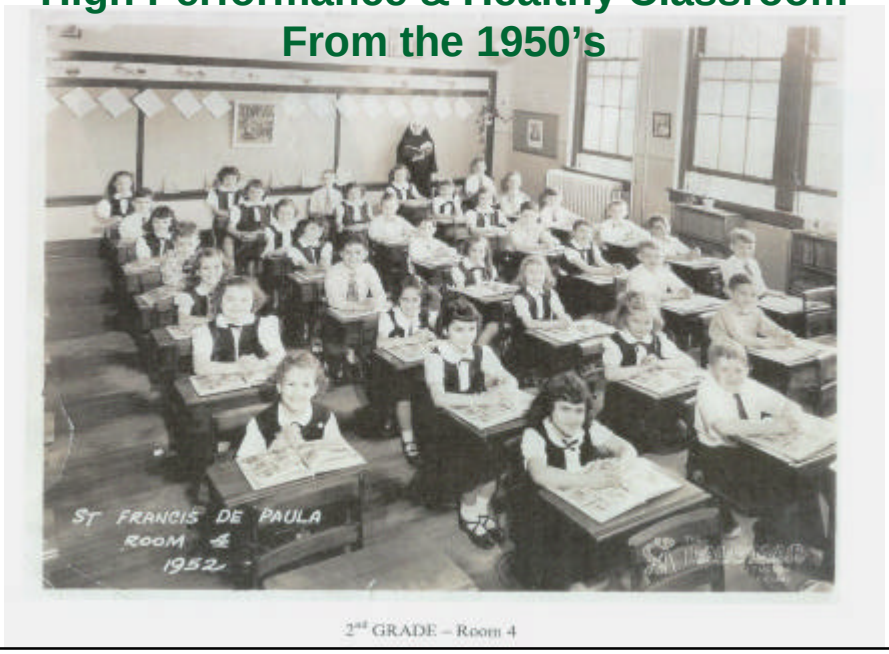
Where

We Learn Here and Where We Learn Matters

by **Center for Green Schools**

http://vimeo.com/44162315

High Performance & Healthy Classroom From the 1950's



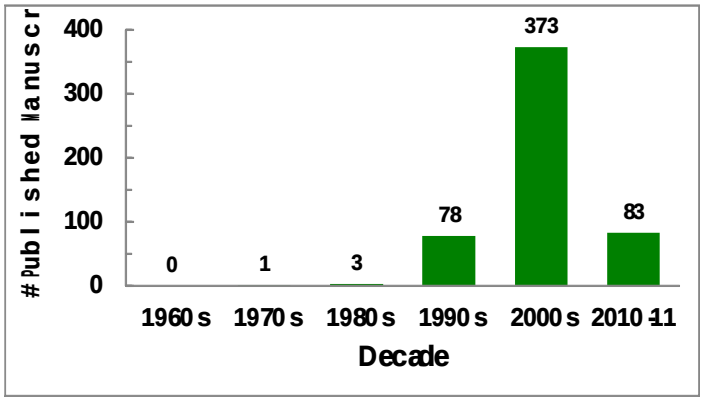
2nd GRADE – Room 4

Unhealthy Classroom of the 2000's

Classroom of the Future?

http://www.carpediemaz.com/learning-centers/

New Research on Indoor Environments in Classrooms



Source: Richard L. Corsi, Ph.D. www.ce.utexas.edu/faculty-directory/profiles/richard-corsi.html
Professor - E. C. H. Bantel Professor for Professional Practice. Uni. of Texas, Civil, Architectural and Environmental Engineering Department-EWRE, Austin TX

Format for Presentation

Research Study

- A research study is an organized activity that is done to determine an answer to a question or problem.
- Doctors and scientists perform research studies because they do not know or understand health needs, problems, or causes for health issues

Actual Experience

- the process or fact of personally observing, encountering, or undergoing something
- the observing, encountering, or undergoing of things generally as they occur in the course of time
- knowledge or practical wisdom gained from what one has observed, encountered, or undergone

Ingredients & Health Information

Kellogg's®
Smart Start® Healthy Heart

Nutrition Facts

Serving Size 1 1/4 Cups (60g/2.1 oz.)
Servings Per Container About 7

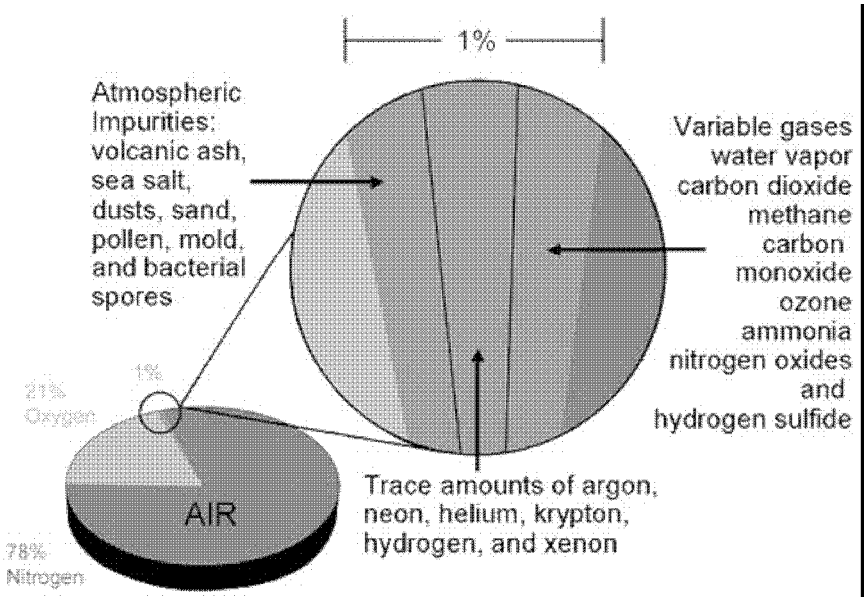
Amount Per Serving	Cereal	Cereal with 1/2 Cup Vitamins A&D Fat Free Milk
Calories	230	270
Calories from Fat	20	20
	% Daily Value**	
Total Fat 3g*	**5%**	**5%**
Saturated Fat 0.5g	**3%**	**3%**
Trans Fat 0g		
Cholesterol 0mg	**0%**	**0%**
Sodium 140mg	**6%**	**8%**
Potassium 400mg	**11%**	**17%**
Total Carbohydrate 46g	**15%**	**17%**
Dietary Fiber 5g	**23%**	**23%**
Soluble Fiber 2g		
Insoluble Fiber 3g		
Sugars 17g		
Other Carbohydrate 24g		
Protein 7g		

Ingredients: Oat bran, rice, sugar, oat clusters (sugar, toasted oats [rolled oats, sugar, high fructose corn syrup, partially hydrogenated soybean oil, molasses, honey], wheat flakes, crisp rice [rice, sugar, malt, salt], corn syrup, polydextrose, honey, cinnamon, BHT for freshness, artificial vanilla flavor), high fructose corn syrup, malt flavoring, potassium chloride, salt, baking soda, ascorbic acid (vitamin C), niacinamide, zinc oxide, reduced iron, calcium pantothenate, pyridoxine hydrochloride (vitamin B_6), riboflavin (vitamin B_2), thiamin hydrochloride (vitamin B_1), BHT (preservative), vitamin A palmitate, folic acid, vitamin B_{12}, vitamin D.

CONTAINS WHEAT INGREDIENTS.

Exchange: 3 Carbohydrates
The dietary exchanges are based on the *Exchange Lists for Meal Planning*, ©2003 by The American Diabetes Association, Inc. and The American Dietetic Association.

Ingredients of Air

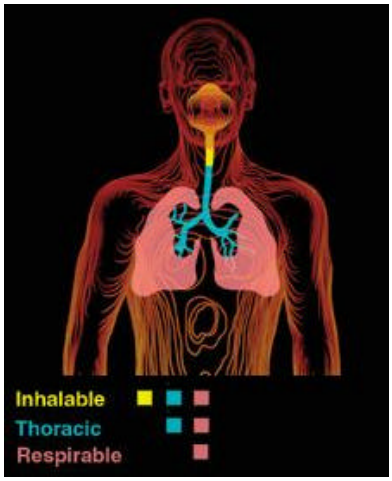


Breathing effects ones health and ability to learn

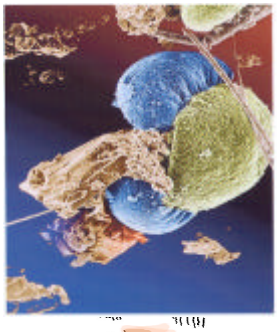
In one day….

take 20,000 breaths

= 35 pounds
= 3,400 gallons
= 450 cubic feet



Over the course of the day...



Breathe in 20 billion particles

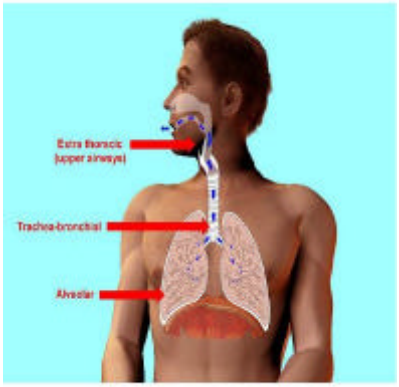
- Consists of
  - dust and combustion particles,
  - volatile organic compounds,
  - irritants and toxins,
  - allergens and asthmagens, and
  - microbial life
- The nose traps and filters up to 70 % of these particles.
- Particles are too small to be trapped by the nose enter the airway.

Effects of Inhalation of Airborne Contaminants

Air particulate exposure and air pollutants exert adverse effects directly on the lungs and heart causing

- respiratory conditions,
- asthma symptoms,
- acute bronchitis,
- cardiovascular conditions,
- blood pressure increases
- atherosclerosis.

Calderón-Garcidueñas



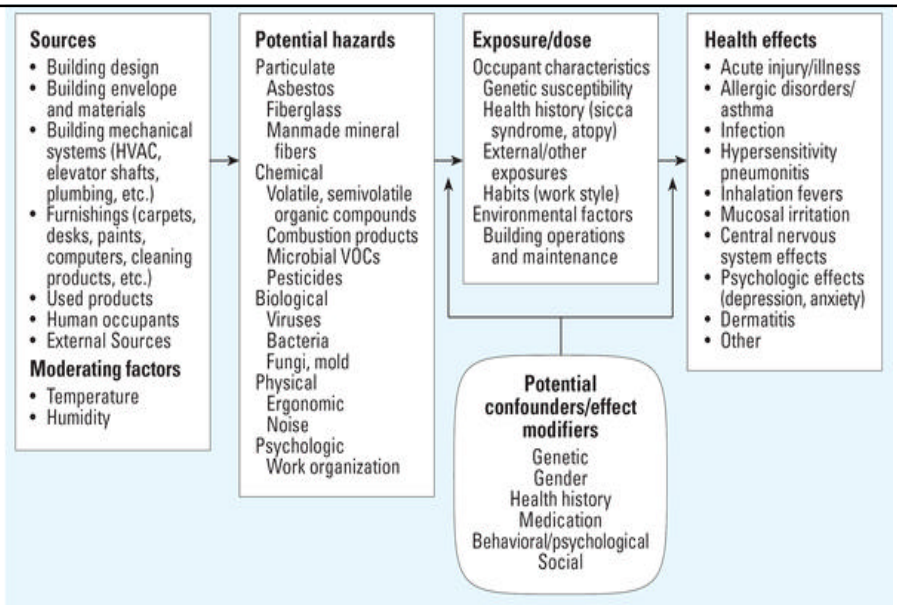
Recent research studies suggest that inhaled ultrafine particles may be capable of entering the brain in children which then effects their ability to learn

The 3 P's of Environmental Health

PEOPLE

PATHWAYS

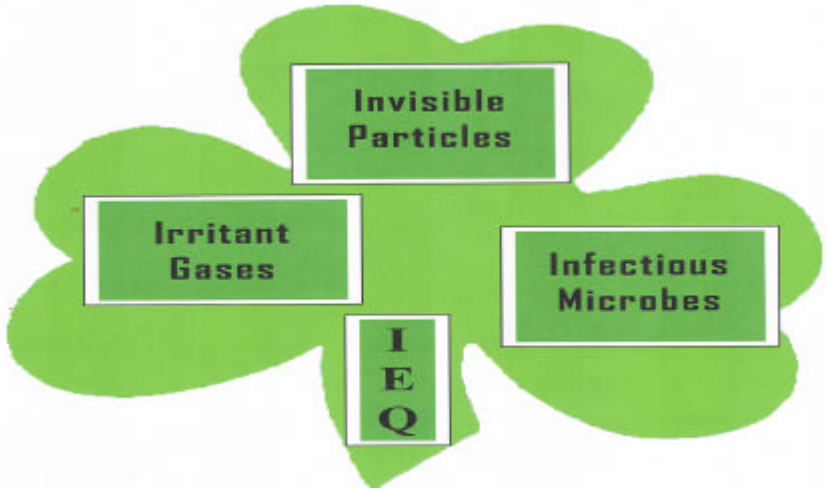
POLLUTANTS



Pathway from built environment to health effects

(adapted from Mitchell CS, Hodgson MJ, unpublished data).
Source: F. Wu, D. Jacobs, et al, Improving Indoor Environmental Quality for Public Health: Impediments and Policy Recommendations, Environmental Health Perspectives, Vol. 115 June 2007

The 3 I's of School
Indoor Environmental Quality



The 3 I's of IEQ can affect health and attendance

1. **Invisible Particles**

Aerosols Levels in the classroom

Airborne particles have the potential to cause allergic reactions, skin irritation, coughing, sneezing, respiratory difficulties and circulatory system problems.

2. **Irritant Gases**

Ventilation Practices for the classroom

Total volatile organic compounds (TVOC), formaldehyde, body odors, and biological contaminants are causes for occupant discomfort and poor health outcomes.

3. **Infectious Microbes**

Cold/Flu Virus Transmission Paths in the classroom

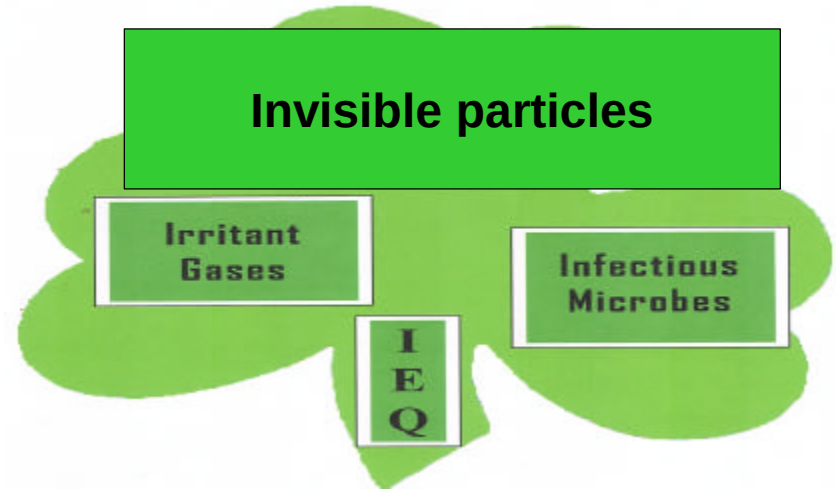
Bacterial and Viral respiratory tract infections, particularly of rhinoviruses, are associated with the majority of asthma exacerbations in both children and adults.

Invisible particles + Irritants + Infections = Inflammation process

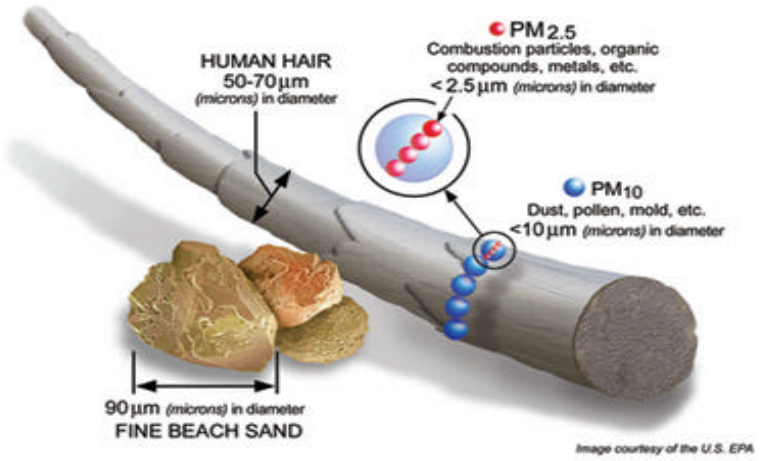
Sources of the 3 I's

- **Outside Air for Ventilation**
  - EPA NAAQS Pollutants
  - Toxic Gases
  - Airborne Microbes
- **Occupants**
  - Acetone
  - Ammonia
  - Hydrogen Sulfide
  - Infectious Microbes
- **Building Materials & Processes**
  - Formaldehyde
  - Total Volatile Organic Compounds
  - Asbestos and Lead
- **Infiltration from open penetrations**
  - Atmosphere Dust
  - Combustion Gases
  - Airborne Microbes
  - Animal borne Microbes

Assessing the School Environment



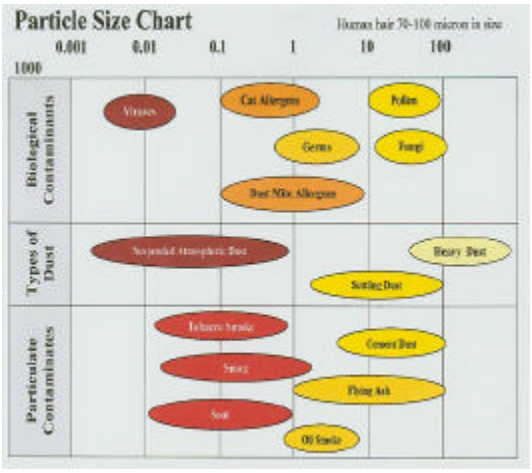
Invisible Particle Size Relationship



Invisible Particles In Dust

- Animal dander
- Household dust
- Insect parts
- Pollen
- Pesticides
- Combustion by-products
- Microbes

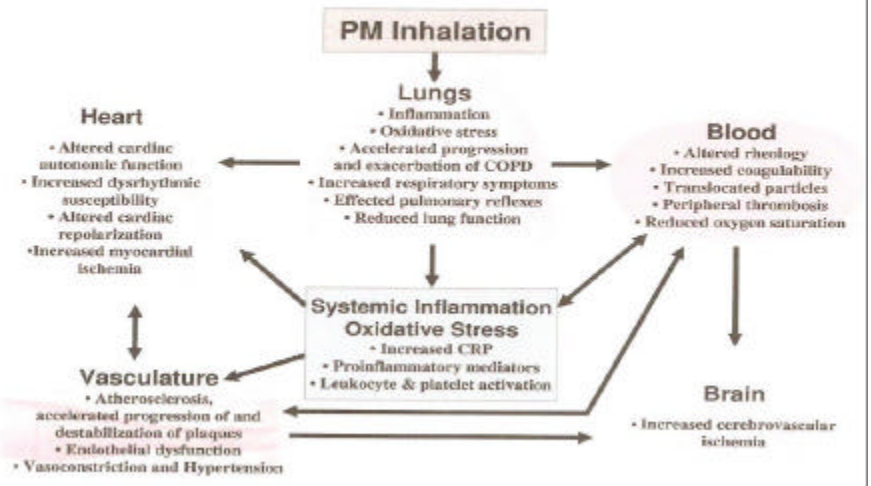
- Common Reservoirs:
  - Carpets, pillows, couches, stuffed animals



Fine Air Particle ($PM_{2.5}$) in Perspective

- One micron = 1/25,000 of an inch in diameter
- $PM_{2.5}$ = 1/10,000 of an inch in diameter
  - 10 micron – the smallest particle the human eye can see
  - Human hair – 35-200 micron
- The body offers no natural defense against particulate 2.5 micron and smaller
- $PM_{2.5}$ or less
  - Most bacteria
  - Diesel particulate and oil smoke
  - Fumes
  - Unsettling atmospheric impurities

Invisible Particle Health Effects



Source: Pope and Dockery, 2006

http://www.noaca.org/pmhealtheffects.pdf

Research Finds That Particle Size & Quantity Matters

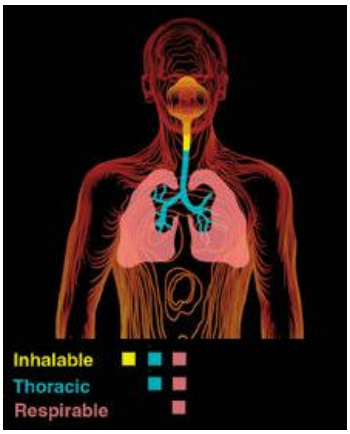
- An increase in 10 micrograms per cubic meter of indoor course particle pollution, there is a 6 % increase in the number of days of cough, wheeze, or chest tightness in asthmatic children.
- An increase in 10 micrograms per cubic meter of indoor fine particle pollution, there is a 7 % increase in days of wheezing severe enough to limit speech.

Source: Johns Hopkins University School of Medicine February 2009

Research Shows The Effects of Fine Particles

A decrease of 10 micrograms per cubic meter of fine particle air pollution results in an

- **increase in life expectancy of 0.7 years**
- **in a 10% decrease in the risk of premature death**



Sources: Harvard School of Public Health, Jan. 2009
American Lung Association, Highlight of recent Research on Particulate Air Pollution: Effects of Long Term Exposure, www.lungusa.org Oct. 2008

Outside Air in San Antonio

Typical San Antonio Day
AQI 30
10 µg/m^3

Air Quality Health Alert Day
in San Antonio
AQI 108
40 µg/m^3

EPA Proposed PM Standard

For long-term effects of fine PM ($PM_{2.5}$), EPA's Clean Air Scientific Advisory Committee (CASAC) recommended the primary health standard be tightened from a current annual average of 15 µg/m^3 to somewhere in the range of 11–13 µg/m^3.

The EPA is proposing a standard in the range of 12–13 µg/m^3 and

is accepting public comments on levels down to 11 µg/m^3.

With $PM_{2.5}$ standards of 13 µg/m^3(annual) and 35 µg/m^3 (24-hour), the annual health benefits are $88–220 million, with costs of $2.9 million.

Substituting an annual standard of 12 µg/m^3 , the EPA estimates the annual health benefits are $2.3–5.9 billion, with costs of $69 million.

At an annual standard of 11 µg/m^3, the EPA estimates the annual health benefits would be $9.2–23.0 billion, with costs of $270 million.

About 30% of the U.S. population lives in the 191 counties or parts of counties designated as "nonattainment" for the current annual PM2.5 standard. The agency also calculated a scenario with an annual standard of 11 µg/m3 and a 24-hour standard of 30 µg/m3. Both the benefits and implementation costs are estimated to be roughly 50% higher than the configuration of 11 µg/m3 (annual) and 35 µg/m3 (24-hour).

Weinhold B 2012. EPA Proposes Tighter Particulate Air Pollution Standards. Environ Health Perspect 120:a348-a349. http://dx.doi.org/10.1289/ehp.120-a348a

http://ehp03.niehs.nih.gov/article/fetchArticle.action?articleURI=info%3Adoi%2F10.1289%2Fehp.120-a348a#r3

http://www.catf.us/resources/publications/files/SickOfSoot.pdf

Actual Experience Shows Benefits of Air Cleaning in Schools

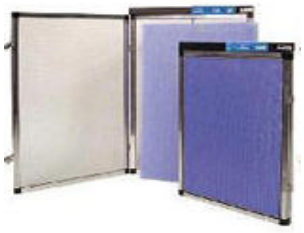
- Teachers report less problems with sore and scratchy throats, runny eyes, and loss of voice during the school day
- Students report less symptoms of respiratory illness and asthmatic experience less breathing problems requiring use of reliever medication

http://www.neisd.net/athletics/PE/documents/DetectingAerosolsPPP.pdf

Actual Air Particle Reduction Methods

Improve Air Filtration

ASHRAE Filter Rating of MERV 8 to MERV 13 and Polarized Media Devices



Reduce Classroom Clutter and Furnishings

Airborne Particle Counts

Portable Hand Held Particle Counter

Six Channels of Particle Sizes from .3 to 10 Micrometers in diameter

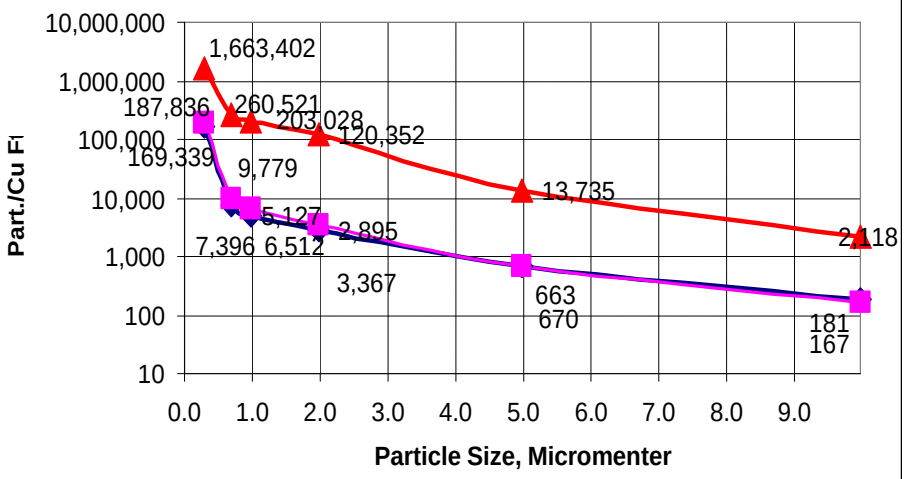
Cleanroom PM Standards

	Class Particulate Limits					
ISO Classification	0.1 µm	0.2 µm	0.3 µm	0.5 µm	1.0 µm	5.0 µm
	m^3	m^3	m^3	m^3	m^3	m^3
1	10	2				
2	100	24	10	4		
3	1000	237	102	35	8	
4	10000	2370	1020	352	83	
5	100000	23700	10200	3520	832	29
6	1000000	237000	102000	35200	8320	293
7				352000	83200	2930
8				3520000	832000	29300
9				35200000	8320000	293000

Cleanrooms are required for manufacturing of electronics, drugs, food and beverage plants

http://www.rimbach.com/cgi-bin/Article/IHN/Number.idc?Number=118

Particles In Classrooms



Ten fold decease in Fine Particles after Cleaning in Room

Source Control for Air Particles

Keep Dirt Out of the School Building

Barrier (walk-off) mats can be used effectively in all entryways into the building.

Source: http://www.epa.gov/iaq/largebldgs/i-beam/visual_reference/chapter_1.html

Aerosol Levels after Construction Activities

Visual Airborne Fine Particle Contamination in Main Entrance Hallway

Portable HEPA Filter

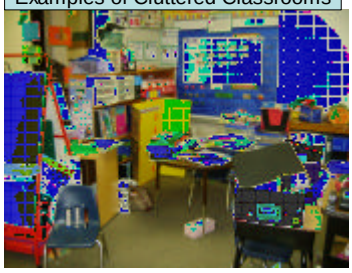
Portable HEPA Filter/Scrubber removed ultrafine particles from over 3 million particles per cubic foot to less than 1 million particles per cubic foot

Classroom Clutter Effects

Particle Reduction Methods

- To improve the efficiency Custodial cleaning practices
- Gives more space of in classroom for movement
- Reduces dust collection and microscopic particle counts

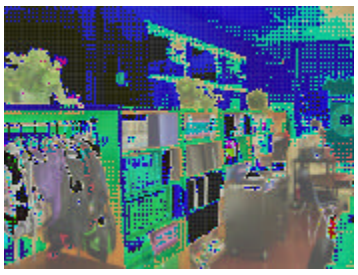
Examples of Cluttered Classrooms



Removal of Clutter

Action: Reduced Classroom Clutter and Furnishings

- Walk through Assessments
- Healthy Tips for Classrooms
- Asthma Friendly Campus Award program



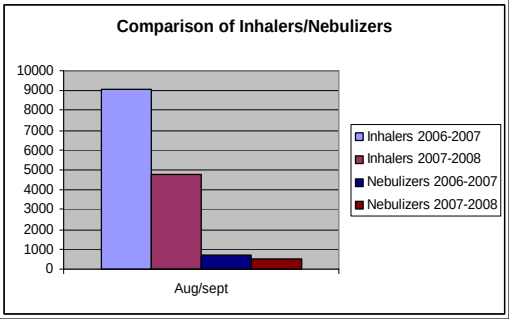
Examples of Organized Classrooms

Actual Experience Shows Benefits of IAQ Intervention Program in Schools

"In North East ISD of nearly 70,000 schoolchildren, there were an extraordinary 9,000 trips to school nurses during the first six weeks of classes before the environmental intervention program began.

The next year, school nurse visits dropped like a rock to half as many during the same period"

Diane Rhodes, Asthma Educator
Allergy & Asthma Today vol 9 no 3, 2011



Results of student Inhaler /Nebulizer Usage after initiating 'Tips for a Healthy Classroom' and 'Asthma Trigger Education' began being communicated to staff.
Data comes from the time period of first six weeks of school which is when 'most problematic' allergy seasons are dormant.
from North East ISD Department of Environmental Health

"A significant increase in hospital admissions for asthma (20% to 300%) was associated with school return after each break. The strongest associations were observed following summer vacation and for children age 5 to 11 years." by Shao Lin, Rena Jones, Xiu Liu, Syni-An Hwang, Impact of the Return to School on Childhood Asthma Burden in New York State International Journal of Occupational and Environmental Health, Vol 17, No 1 (2011)

School Location Near Major Highway

One recent research study revealed a significant 24% increase in the risk of experiencing multiple emergency department contacts for asthma for every log-unit of traffic exposure.

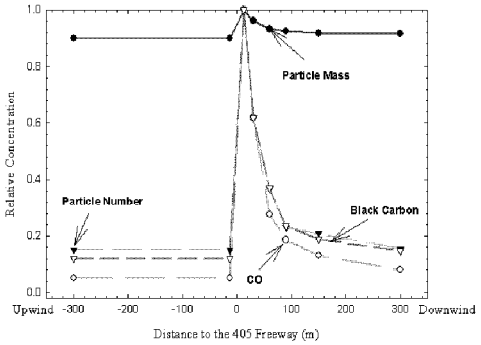
Another study found pronounced deficits in attained lung function at age 18 years were recorded for those living within 500 m of a freeway

Use of a total traffic count metric to investigate the impact of roadways on asthma severity: a case-control study

Cook et al. Environmental Health 2011, 10:52
http://www.ehjournal.net/content/10/1/52

Effect of exposure to traffic on lung development from 10 to 18 years of age: a cohort study

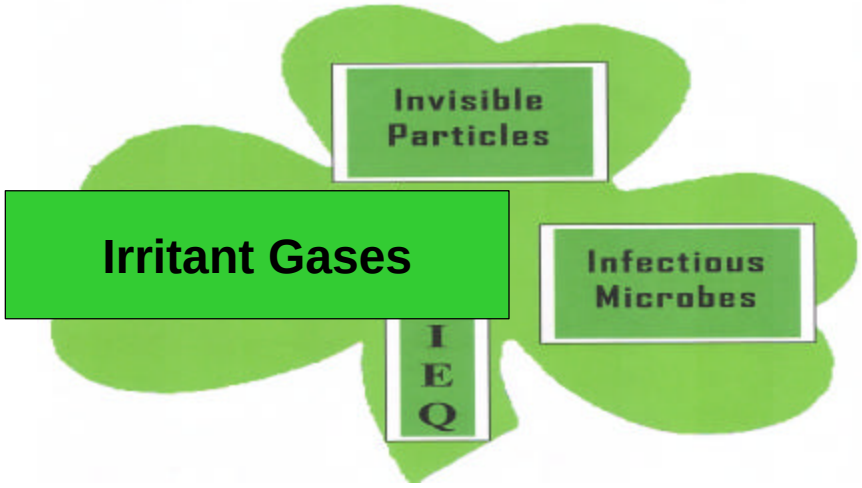
W James Gauderman et al
http://www.thelancet.com/journals/lancet/article/PIIS0140-6736(07)60037-3/abstract



Yifang Zhu, William C Hinds, Seongheon Kim, Si Shen, Constantinos Sioutas, Study of ultrafine particles near a major highway with heavy-duty diesel traffic *Atmospheric Environment, Volume 36, Issue 27, September 2002, Pages 4323-4335*

http://www.epa.gov/ncer/reports/r827352C006fr.pdf

Assessing the School Environment



Outside Air Contaminants

- Ozone; Hot & Sunny Days
- Water Vapor in Hot and Humid Climates
- Other Gases; Sewer, Boiler Gas, Industrial
- Chemical and Biological Threats; Pranksters
- Particles; Especially from Combustion Fumes
- Pollen, Spores, Allergens, & Microbes

Source: ASHRAE 62.1-2007

Source: www.airnow.gov

Sources of Irritant Gases

Occupant driven Irritants

Formaldehyde and VOCs

- can arise from sources such as new linoleum flooring, synthetic carpeting, particleboard, wall coverings, furniture, and recent painting—have been implicated as potential risk factors for the onset of asthma and wheezing

- Chemicals
- Cleaning Supplies
- Scented Materials
- Occupant Practices

Sources of Irritant Gases

CLEAN AIR ROOMS

Allergy Friendly Rooms

Scented Products Use Rules

Many chemicals contained in scented products are known to be respiratory irritants. Even at very low concentration levels, they can trigger a wide range of adverse, and sometimes severe, physical responses in individuals with respiratory sensitivities.
For example, affected individuals can experience asthmatic reactions, such as difficulty breathing, excessive coughing, irritated eyes and nose, etc. Other responses could include migraine headaches, itchy, sore skin, tingling body parts, rashes, severe headaches, nausea, dizziness and shortness of breath. When exposure is indoors, the impact is magnified.

http://www.ehs.utoronto.ca/resources/HSGuide/Scent.htm

http://www.yorku.ca/dohs/doc/GuidelinesNotices/ScentedProducts/scentedproduct.pdf

Sources of Irritant Gases

Entrainment of Irritant Gases

Sewer vent gases and boiler combustion vent gases are entrained with the outside air with the intake hoods are located too close on the roof

Research Shows the Health Effects of Irritant Gases

The research study data available suggests that

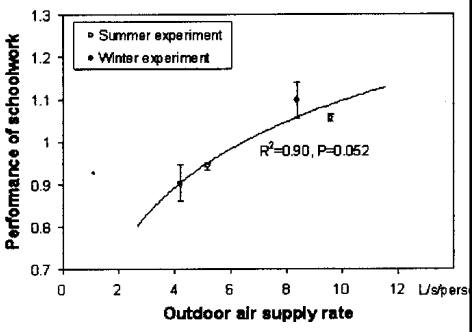
- **indicators of inflammation,**
- **rates of communicable respiratory infections,**
- **frequency of asthma symptoms and**
- **rates of short-term sick leave**

increase with lower ventilation rates in the building environments studied

"Ventilation rates and health: multidisciplinary review of the scientific literature"
by J. Sundell, H. Levin, W. W. Nazaroff, W. S. Cain, W. J. Fisk, D. T. Grimsrud, F. Gyntelberg, Y. Li, A. K. Persily, A. C. Pickering, J. M. Samet, J. D. Spengler, S. T. Taylor, C. J. Weschler

Research Shows the Test Score Effects of Irritant Gases

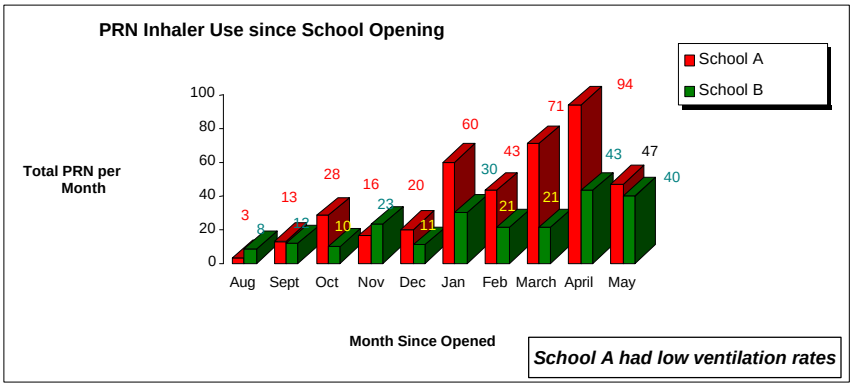
For every unit (1 l/s per person) increase in the ventilation rate, the proportion of students passing standardized test (i.e., scoring satisfactory or above) is expected to increase by 2.9% (95%CI 0.9–4.8%) for math, 2.7% (0.5–4.9%) for reading.



Sources:
Dr. Richard Shaughnessy, Indoor Air Program, Uni. of Tulsa
Dr. P. Wargocki, International Centre for Indoor Environments, Uni. of Denmark

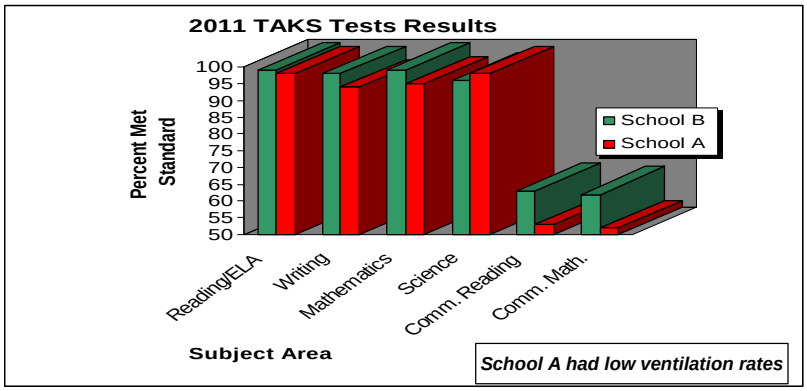
Indoor Air Quality Scientific Findings Resource Bank (IAQ-SFRB),
Indoor Environment Department of the Lawrence Berkeley National Laboratory
www.iaqscience.lbl.gov/sfrb.html

Actual Experience Shows Health Benefits of Ventilation in Schools



The 93 asthmatic students at School A were requesting their PRN inhaler at 2 to 3 times more than the 102 asthmatic students at School B

Actual Experience Shows Test Score Benefits of Ventilation in Schools



School B had higher percentages (up to 4% higher) of students passing reading, writing and mathematics sections.
School B had 11% and 16% more students than School A obtaining the Commended Level on the reading and mathematics tests (students correctly answered 90% or better of the TAKS questions).

Ventilation Rate and Air Pollutants

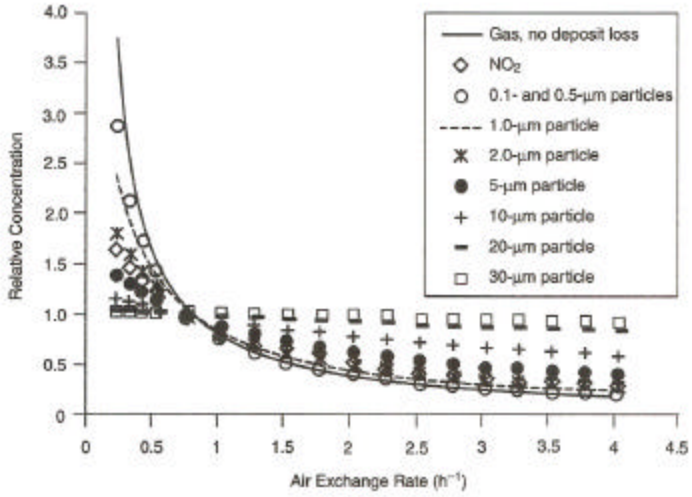
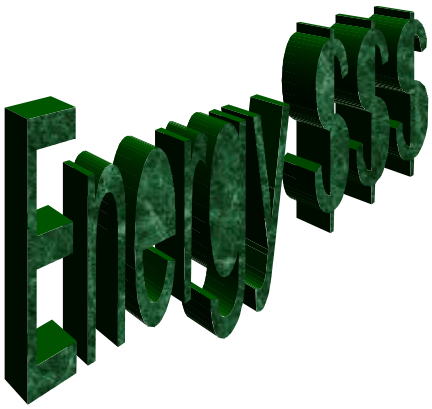


FIGURE 10-1 Predicted trends in the relative concentrations of indoor-generated pollutants with ventilation rate.

Ventilation Air Energy Penalty

- Fan energy is required to force outside air into the school building
- Fan energy is required to exhaust air from the school building,
- Thermal energy is required to cool, heat and dehumidify outside to indoor comfort conditions
- Energy Cost is about **$1.50/Cubic Feet/Minute**



Source: J. Dieckmann, et al, “Air Purification to Reduce Outside Air”, ASHRAE Journal April, 2009, pps 68-70

Benefits of Applying ASHRAE’s 62.1 IAQ Procedure

The IAQ Procedure in ASHRAE Standard 62.1-2010 may be used to determine outdoor air ventilation rates.

The IAQ Procedure requires the building and its ventilation system to be designed to achieve both objective and subjective criteria.

- Identify contaminants of concern;
- Determine acceptable contaminant concentrations;
- Specify the perceived indoor air quality criteria;
- Apply an acceptable design approach to achieve the performance criteria.

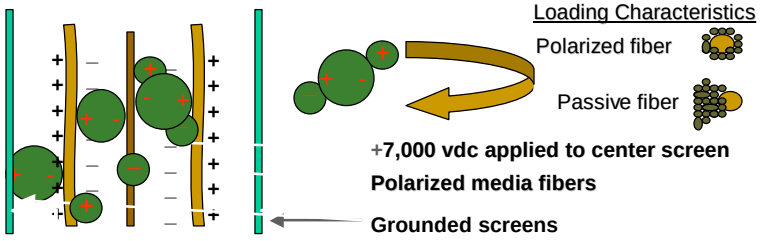
Gas Phase Filtration Media

- Media is a combination of activated carbon, and an activated alumina substrate impregnated with sodium permanganate.
- By using these media in combination, the removal of most irritant gases is achieved.

Air Cleaning in Practice – School Sustainability and Commercial Building Field Study Results
http://www.purafil.com/PDFs/Technical%20Papers/Commercial/Air%20Cleaning%20in%20Practice%20(IAQA%202009).pdf

Polarized Media Filtration Devices

- Electrostatic attraction & Agglomeration
- Ability to collect particles < 0.3 Microns



Green Cleaning in Schools

Cleaning Chemicals and Dispensing Systems that do not contain harmful ingredients and vapors

Cleaning for Healthy Schools
http://www.cleaningforhealthyschools.org/

Volatile Organic Compounds (VOC) in Perspective

- Volatile Organic Compounds = VOCs = Odors & Irritants &Toxicity
  - Many sources include microbial life forms
- Too small to remove through regular filtration
  - Many under 0.001 micron
  - Removed by adsorption with carbon or other adsorbent material in gas phase filters
  - Removed by capture with ultra fine particles in polarized media filtration devices
  - Measurable with portable handheld devices

Asthma Risk and VOC Level

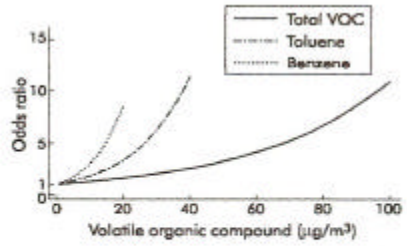


Figure 2 Asthma in young children associated with exposure to indoor volatile organic compounds (μg/m³): odds ratios adjusted for age, sex, atopy, socioeconomic status, smoking indoors, air conditioning, house dust mites, and gas appliances.

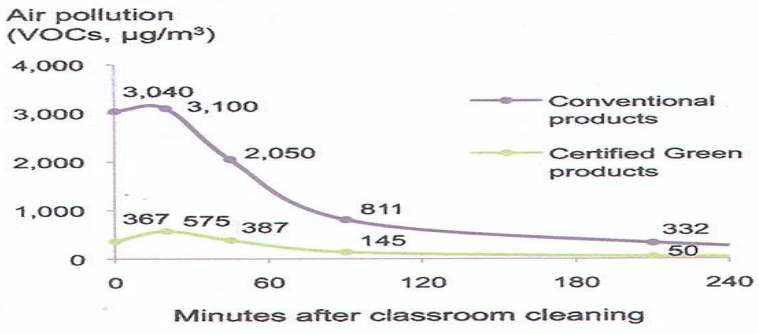
For every 10 unit increase in the concentration of toluene and benzene (μg/m³) the risk of having asthma increased by almost two and three times, respectively.

Source: Association of domestic exposure to volatile organic compounds with asthma in young children, K Rumchev, J Spickett, M Bulsara, M Phillips, and S Stick

http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1747137/?tool=pubmed

Research Shows the Benefits of Green Cleaning Products

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



Ten fold decease in Total VOCs after Green Cleaning in Room

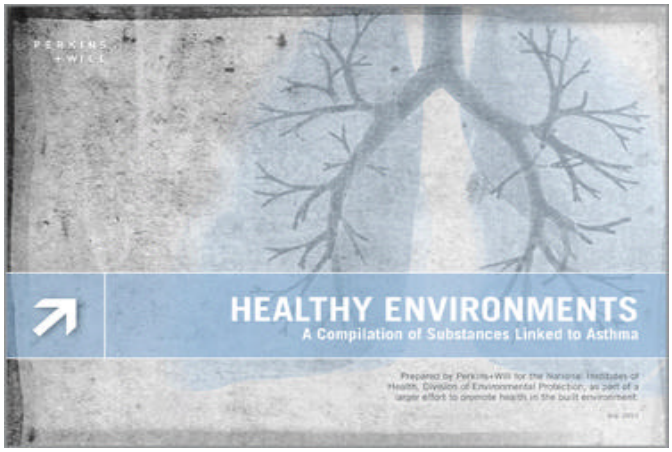
Source: http://www.ewg.org/files/2009/10/school-cleaners/EWGschoolcleaningsupplies.pdf

Actual Experience Shows Benefits of Green Cleaning Practices

- **North East ISD** reported a savings of 30% in Custodial costs and a reduction of 25% in Sick Days among Custodial and Maintenance team after switching to Green Cleaning Chemicals
- **Lockport Township High School**, in Lockport, Ill., reported a 3% increase in the average daily attendance after the first year of implementing an Indoor Air Quality (IAQ) Management plan that included green cleaning
- Three states required the use of certified green cleaning products in schools (NYS-2005, Illinois- 2007, Connecticut - 2009).

http://www.healthyschoolscampaign.org/programs/gcs/success.php
http://www.cleaningforhealthyschools.org/documents/FAQs.pdf
http://media.cefpi.org/southern/EPA_GreenCleaning.pdf

Source Control for Irritant Gases

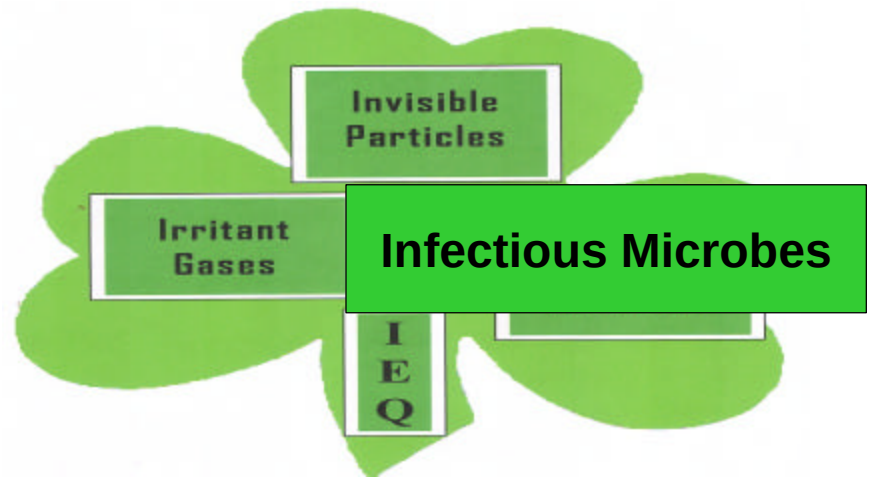


Healthy Environments: A Compilation of Substances Linked to Asthma

Perkins+Will prepared this report on behalf of the National Institutes of Health, Office of Research Facilities, Division of Environmental Protection **August 8, 2012.**

Source: http://transparency.perkinswill.com/Main

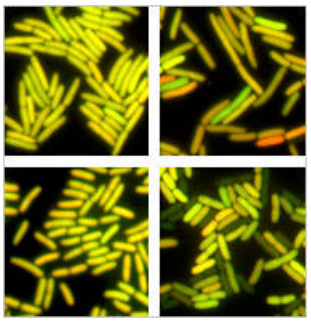
Assessing the School Environment



Beneficial Microbes

- Human Microbiome Project
  - 1000 species of bacteria on human skin

Source: Julia Segre, et al
National Institutes of Health May 29, 2009



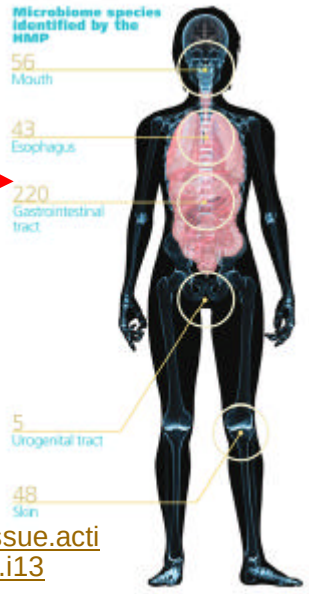
- Home Land Security Project
  - 1800 types of airborne microbes in Austin and San Antonio ambient air

Source: Gary Anderson, et al,
Berkley National Laboratory
National Academy of Sciences December 19, 2006

Infectious Microbes

Viruses, bacteria, amoebae, fungi, and other microbial parasites can invade the human body

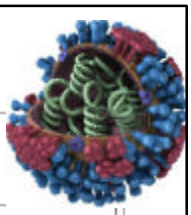
- 100 Trillion Bacteria cells on/in human body
- 100 Bacteria species pathogenic to humans
- 33% Humans carry M. tuberculosis
- 50% Humans carry H. pylori
- 50% Humans carry S. Aureus

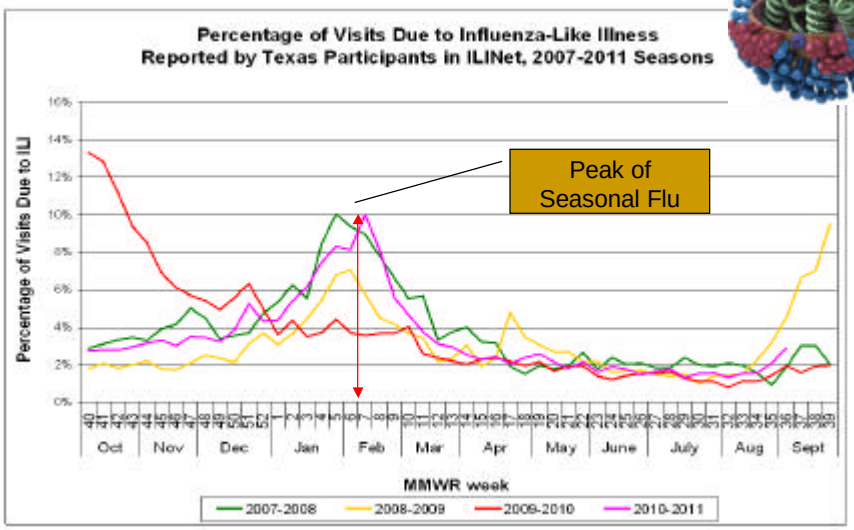


Source: B. Brett Finlay
The Art of Bacterial Warfare, Scientific American
February, 2010 pps 56-63

http://www.ploscollections.org/article/browseIssue.action?issue=info:doi/10.1371/issue.pcol.v01.i13

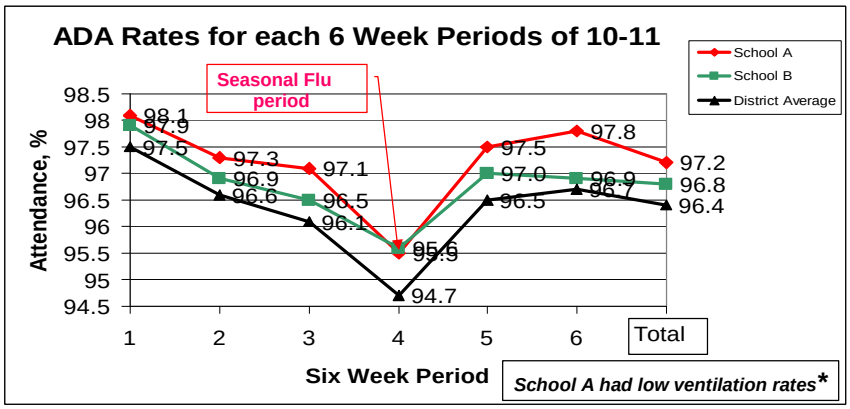
Tracking Flu Activity





Year 2010-2011 is shown in pink and peaked at 10 % of visits due to Influenza like illness (ILI) in mid February
Source: http://www.dshs.state.tx.us/idcu/disease/influenza/surveillance/2011/

Actual Experience with Seasonal Flu



4th 6 Weeks are during Jan and Feb and has about a 2% drop in ADA from other 6 Week Periods

* Li Y, et al., Role of ventilation in airborne transmission of infectious agents in the built environment: a multidisciplinary systematic review. Indoor Air 2007;17:2-18.

Research Shows the Effects of Infectious Microbes

- **Research evidence suggests that a large portion of enteric and respiratory illnesses can be prevented through improved environmental hygiene, with an emphasis on better hand and surface cleaning practices.**

Source:

International Scientific Forum on Home Hygiene. 2002.

The infection potential in the domestic setting and the role of hygiene practice in reducing infection. http://www.ifh-homehygiene.org

Actual Experience Shows Health Benefits of Hygiene in Schools

Good hand and surface hygiene can reduce illness and school absenteeism rate among children and adults by 30% to 50%

Source: Charles P. Gerba, Ph.D University of Arizona
Cleaning Up: Battling Germs in School Facilities. *School Business Affairs* volume 75, number 2, Association of School Business Officials International February, 2009.

Actual Experience Shows Health Benefits of Hygiene in Schools

Healthy Schools, Healthy People,
It's a SNAP!
(School Network for Absenteeism Prevention)
joint initiative of the Centers for Disease Control and Prevention and American Cleaning Institute.

A study involving Detroit school children showed that scheduled handwashing, at least four times a day, can reduce gastrointestinal illness and related absences by more than 50%.[1]

Global Handwashing Day
October 15

Sources: http://www.itsasnap.org/snap/about.asp
[1]Matser D, Longe SH, Dickson H. Scheduled hand washing in an elementary school population. Family Medicine. 1997;29(5):336-339

Clean Classroom Hygiene Standard

CIRI & ISSA proposed K-12 Classroom Clean Standard Elements:

(a) **basic or preliminary facilities walk-through**
(b) **recommendations for subsequent ventilation study/IEQ measures**
(c) **visual dust and soils criteria, or settled and measurable dust**
(d) **bio-contamination using adenosine triphosphate, ATP luminescence based on**
(e) **pre-cleaning and post-cleaning assessment of multiple interior surfaces, and**
(f) **record keeping and enhancements or corrective actions.**

Adenosine triphosphate (ATP) meter with capability to measure the level of microbial life present on a high touch and hard classroom surface.

http://www.issa.com/data/File/CIRI/CLEAN%20STANDARD%20OUTLINE_JUNE%202012.pdf

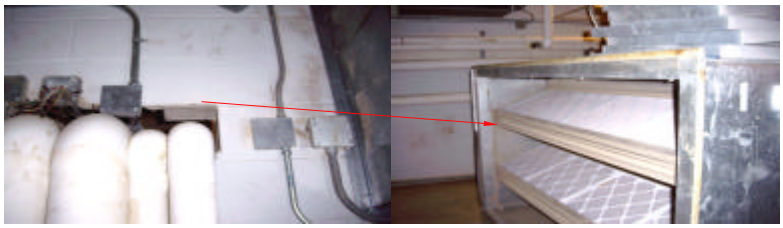
The Case for Touchless Fixtures and Devices

TEDxPhoenix 2009 presents Dr. Charles P. Gerba, Professor at the Colleges of Public Health and Agriculture, University of Arizona.

http://www.youtube.com/watch?v=9RhiHQne63I&noredirect=1

Infiltration From Open Building Penetrations
The Fourth I of IEQ

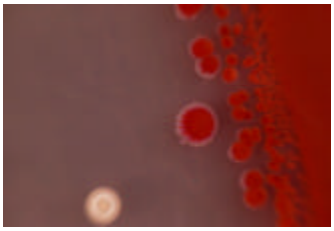
Infiltration From Unsealed Penetrations are a Source of Outside Air Contaminants after Construction



Contaminated air flows through unsealed penetrations for pipe, conduit and duct into the return air conveyance system of HVAC

The 3 M's School Building Health

Moisture

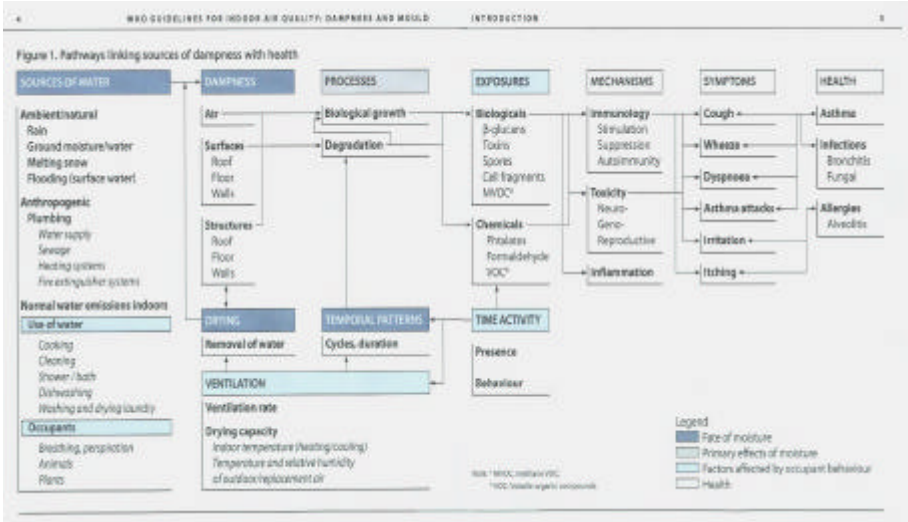


Mold

Microbiome

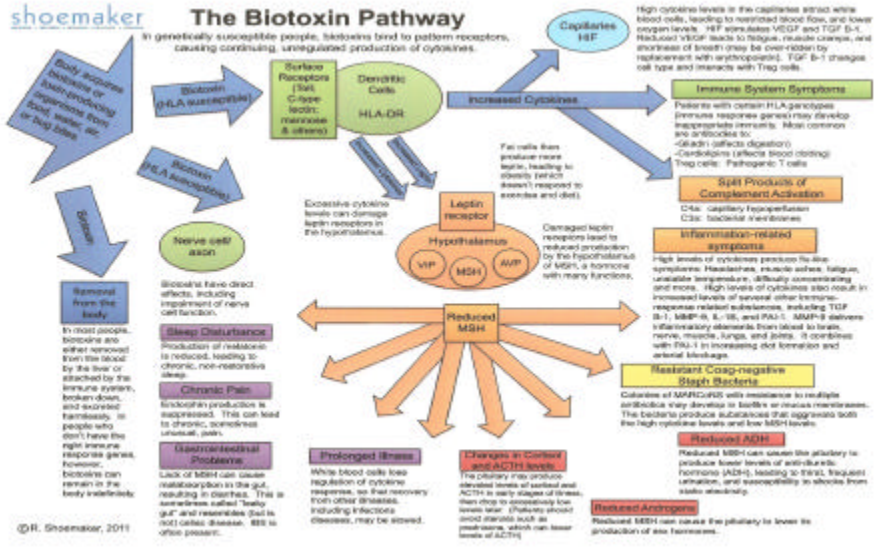
www.microbeworld.org/

Pathways from Water to Health



Source: http://www.euro.who.int/__data/assets/pdf_file/0017/43325/E92645.pdf

Mold in School Buildings



http://www.survivingmold.com/docs/biotoxinpathwayritchieshoemakermd.pdf

Moisture in School Buildings

Draft NIOSH Alert Division of Respiratory Disease Studies

Preventing Occupational Respiratory Disease from Exposures caused by Dampness in Office Buildings, Schools, and Other Non-industrial Buildings

WARNING! Occupants within damp office buildings, schools, and other non-industrial buildings may develop respiratory symptoms and disease.

http://www.cdc.gov/niosh/docket/review/docket238/pdfs/05-IEQ-ALERT-3-30-11.pdf

Revised ASHRAE Position Document

Limiting Indoor Mold and Dampness in Buildings

Special ASHRAE COMMITTEE OBSERVATIONS CONCERNING MOLD AND MOISTURE PROBLEMS IN BUILDINGS

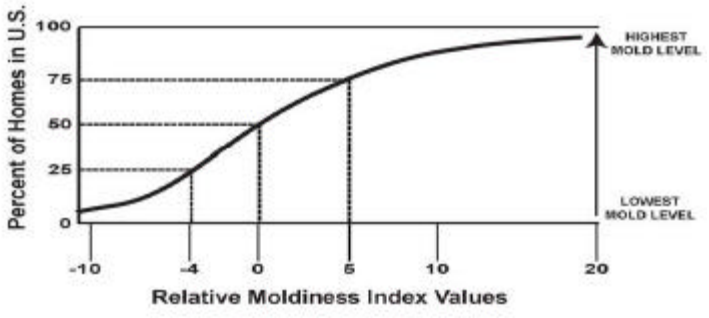
http://www.ashrae.org/about-ashrae/position-documents

Upcoming EPA Guidelines Indoor Environments Division

"Moisture Control In Public And Commercial Buildings:
Guidance For Design, Construction And Maintenance Professionals"

http://www.govenergy.com/2007/pdfs/buildings/Kolb_and_Brennan_Buildings_track_S8.pdf

Environmental Relative Moldiness Index (ERMI)

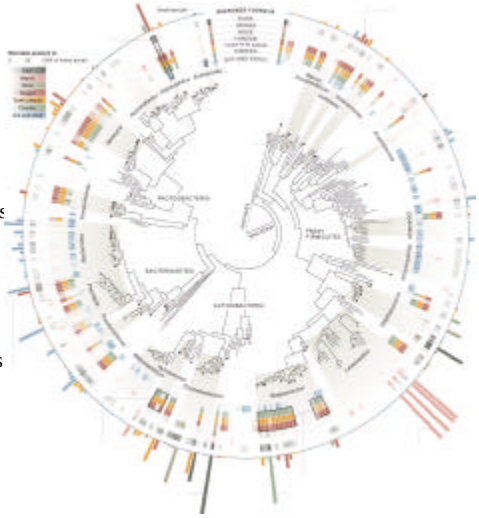


25th Percentile (Low) A home with a index of less than -4 is in the lower quarter (25%) of all the homes. The potential risk of significant indoor mold growth is low.
25th to 75th Percentile (Moderate) Homes with a index of -4 to 5 represent 50% of homes in the moderate range. There is a moderate risk of indoor mold growth for this category.
75th Percentile (High) Homes with a index greater than 5 were in the upper 25% of all homes tested. This category represents the highest potential risk of significant indoor mold growth.
Molds from a 36 species panel are divided into two groups.
The first group (Group 1) of 26 species represents molds associated with water damage and the other group (Group 2) represents common indoor molds. The Index is calculated by log-transforming all mold concentrations, then subtracting the sum of the second group from the sum of the first.
The resulting ERMI is a whole number usually between -10 and 20 with a standard deviation of ± 3.

Source: http://www.epa.gov/microbes/moldtech.htm

Microbiome of Humans and Buildings

- **microbiome** is the totality of microbes, their genetic elements (genomes), and environmental interactions in a particular environment.
- The term "microbiome" was coined by Joshua Lederberg, who argued that microorganisms inhabiting the human body should be included as part of the human genome, because of their influence on human physiology.
- The human body contains over 10 times more microbial cells than human cells, although the entire microbiome only weighs about 200 grams (7.1 oz).
- Microbiomes are being characterized in many other environments as well, including soil, seawater/freshwater systems and buildings.



Information:http://www.yourwildlife.org/the-wild-life-of-our-bodies/

Microbiome of Humans

One person sheds each hour

2,400,000 skin cells

(Motionless, up to 500,000 particles per minute.

When active, this level can reach up to 45,000,000 particles per minute.)

And 35,000,000 bacterial cells

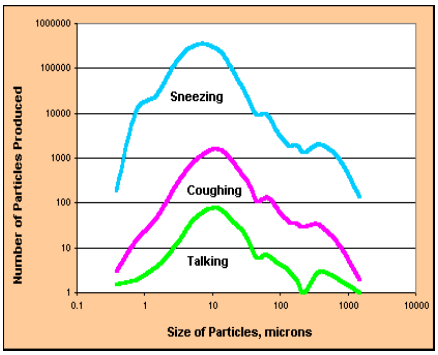
"An important public health consequence…is that through direct inhalation of resuspended or shed organisms there is a potential for current or previous occupants of a room to contribute substantially to inhalation exposure to bioaerosols"

Hospodsky D, Qian J, Nazaroff WW, Yamamoto N, Bibby K, et al. (2012) Human Occupancy as a Source of Indoor Airborne Bacteria. PLoS ONE 7(4): April 18, 2012

Engineering Controls to Reduce Infectious Microbe Transmission.

Strategies for Classrooms

Dilution Ventilation
Personalized ventilation
Source capture
Central system filtration
Local air filtration
Duct UVGI



Add Shed and Resuspended Particles

The ASHRAE Position Document on Airborne Infectious Diseases January 2012

by the Society's Airborne Infectious Diseases Position Document Committee.
http://www.ashrae.org/about-ashrae/position-documents

Built Environment Microbiome Project

BIOLOGY AND THE BUILT ENVIRONMENT

http://biology.uoregon.edu/biobe/

The BioBE Center is based at the University of Oregon and led by

Jessica Green (Director)

Brendan Bohannann

G.Z. (Charlie) Brown

Jessica Green on Building Microbes

Architectural design influences the diversity and structure of the built environment Microbiome.

http://www.nature.com/ismej/journal/v6/n8/pdf/ismej2011211a.pdf

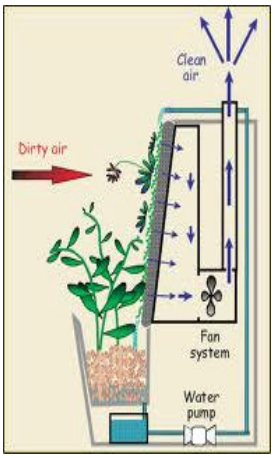
http://www.ted.com/talks/jessica_green_are_we_filtering_the_wrong_microbes.html
http://biology.uoregon.edu/people/green/Science-2012-Humphries.pdf

Living Wall as a Biofilter to Clean Indoor Air of Airborne VOC 's

Dr. David Suzuki PUBLIC SCHOOL

Living Walls break down airborne VOCs, through the process of bio-filtration.

In controlled laboratory studies, a system removed up to 90% of VOCs in a single pass.



http://www.naturaire.com/function

http://www.suzukipublicschool.ca/building-features.html

http://www.hpbmagazine.org/case-studies/educational/dr--david-suzuki-public-school-windsor-ontario-canada

Manage the 3 I's for Green and Healthy Schools and High Achieving Students

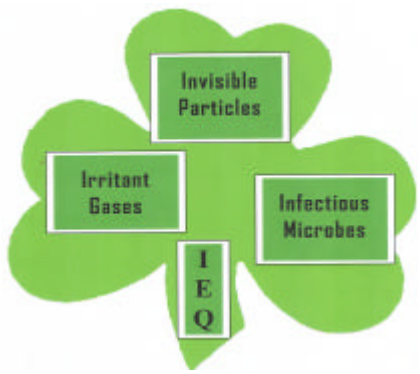
Apply IEQ Research Results to improve Classroom Physical Space

Use Modern IEQ Instrumentation to verify Classroom IEQ Conditions

Place Occupancy Limits on Rooms based on Design Specifications

Include IEQ Expertise on Design and Construction Teams

Monitor Health Clinic Visits to detect any Unforeseen Conditions



The A, B, C, & D Factors

- Acoustics and Noise
- Body/Brain Relationship
- Commissioning of Building and MEP Systems
- Daylighting/Natural Lighting

Research Shows the Effects of Classroom Acoustics

Recent findings show that noise not only causes undue stress to children but also inhibits intellectual and language development. Children exposed to noisy environments are influenced psychologically: for example

- showing increased blood pressure,
- alimentary canal disturbances and
- other somatic problems,

when exposed to constant noise levels of 95 – 125 decibels (dB). Motivation, concentration, and attention are negatively influenced. Disruptive effects upon language comprehension courses were noted at noise levels of 65 – 70 dB; that is, lower and middle schoolchildren could understand only 71% of the language content since consonant sounds were masked.

Torsten Norlander, Leif Moas, and Trevor Archer, *Noise and Stress in Primary and Secondary School Children: Noise Reduction and Increased Concentration Ability Through a Short but Regular Exercise and Relaxation Program*, School Effectiveness and School Improvement, Vol. 16, No. 1, March 2005, pp. 91 – 99

Maxwell, L.E., & Evans, G. (1999). *The effects on pre-school children's pre-reading skills*. Journal of Environmental Psychology, 20, 91 – 97.

Actual Experience Shows Benefits of Classroom Acoustics

- Sufficient evidence suggests that chronic noise exposure at schools affects children's health and performance.
- Adverse effects in children exposed to high levels of noise seem to be reversed if noise is reduced by at least 7 dB(A).
- Detecting benefits requires children being in quieter classrooms for at least 1 year. This needs to be confirmed by future research.
- Noise effects are likely to be reversed more effectively if noise-abatement programs in classrooms are combined with decreasing schools' exposure to environmental noise.

Marie Louise Bistrup: Main editor, Lis Keiding: Co-editor, *Children and noise– prevention of adverse effects*, Report from a project coordinated by the National Institute of Public Health, Denmark Copenhagen 2002

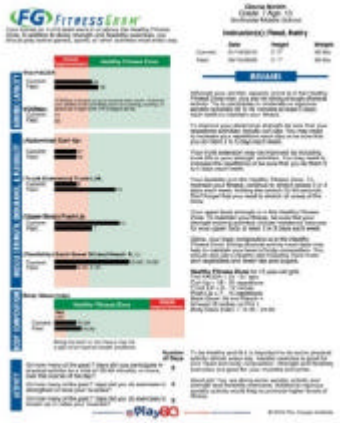
Research Shows the Relationship between the Body and Brain Fitness

2010 literature review done by the Centers for Disease Control and Prevention found that out of 50 studies, more than half showed a positive association between school-based physical activity – such as physical education, recess and extracurricular sports -- and academic performance

http://www.cdc.gov/healthyyouth/health_and_academics/pdf/pape_executive_summary.pdf

Actual Experience Shows Relationship of Body and Brain Fitness

- Researchers analyzed FITNESSGRAM® test results from more than 2.4 million Texas students in grades 3 to 12 during the 2007–08 school year and found significant school-level correlations between physical fitness achievement and better performance on state standardized tests.
- Higher physical fitness achievement also was associated with better school attendance rates and fewer disciplinary incidents involving drugs, alcohol, violence or truancy.
- Associations were stronger for cardiovascular fitness than for measures of body mass index (BMI), but the patterns were consistent.
- The analyses controlled for potential confounding variables, such as socio-economic status, minority status and school size, that could influence the correlations.



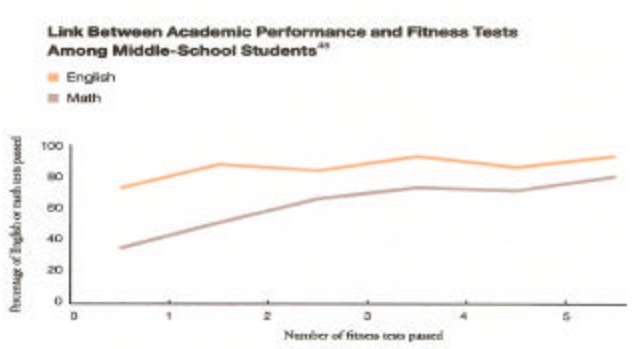
http://www.rwjf.org/files/research/20090925alractiveeducation.pdf

Associations of physical fitness and academic performance among schoolchildren.

Van Dusen DP, Kelder SH, Kohl HW 3rd, Ranjit N, Perry CL.

J Sch Health. 2011 Dec;81(12):733-40.

Actual Experience Shows Relationship of Body and Brain Fitness



Active Education, Physical Education, Physical Activity, and Academic Performance

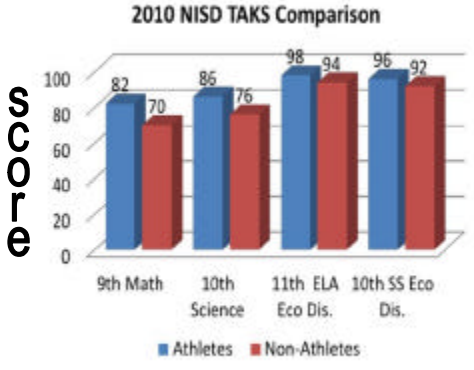
www.rwjf.org_files_research_20090925alractiveeducation

Castelli D, Hillman C, Buck S, et al. "Physical Fitness and Academic Achievement in Third- and Fifth-Grade Students." *Journal of Sport and Exercise Psychology*, 29(2): 239–252, April 2007

Actual Experience Shows Relationship of Body and Brain Fitness

Student athletes out-performed their non-athlete peers in every subject and grade-level on the 2010 Texas TAKS tests.

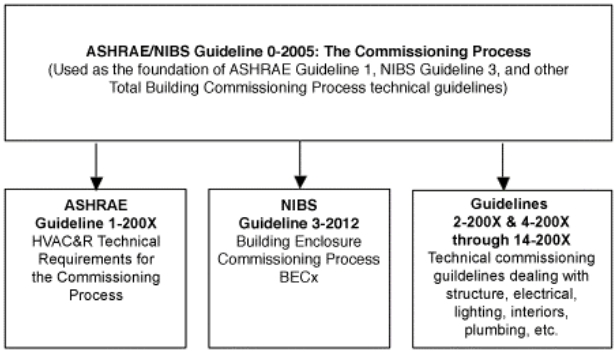
This was especially true in the student group of students identified as economically disadvantaged (a sub-group used by the state for testing purposes).



Friends of Texas Public Schools http://fotps.org/about.php

http://archive.constantcontact.com/fs028/1101110503872/archive/1109576836077.html

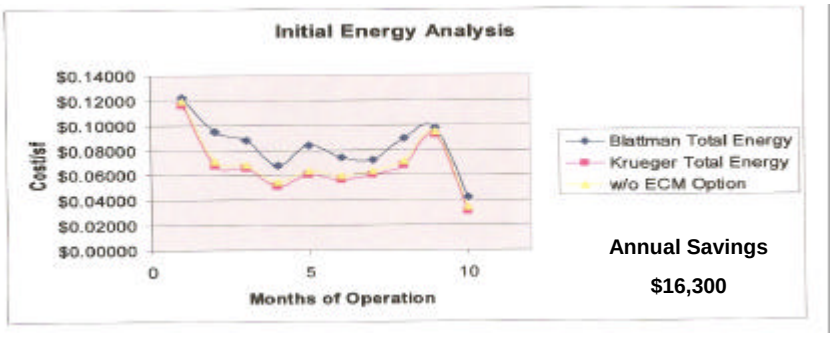
Research Shows the Benefits of Commissioning Building and MEP Systems



Numerous case studies have demonstrated resulting O&M-related energy efficiency improvements on the order of 5% to 30% covering a wide range of building uses. The resulting simple payback periods are typically less than 2 years and often less than 0.5 year.

http://www.epa.gov/iaq/schooldesign/commissioning.html
http://www1.eere.energy.gov/femp/pdfs/OM_7.pdf
http://www.wbdg.org/project/buildingcomm.php#ar

Actual Experience Shows the Benefits of Commissioning Building and MEP Systems



The **Viability of Commissioning** in New School Construction.

Prepared for The Northside Independent School District and

The Texas State Energy Conservation Office May 2007

http://www.beslab.org/The%20Viability%20of%20Commissioning%20in%20New%20School%20Construction%20Final%20Report%20(May%2007).pdf
http://www.beslab.org/CEFPI%20School%20Commissioning%20Presentation%20(April%2007).pdf

Research Shows the Effects of Day Lighting in Classrooms

• A study conducted by the Heschong Mahone Group of 21,000 students in three states found that those in classrooms with the most daylighting progressed
20% faster on math tests and
26% faster on reading tests
in one year than those with the least daylighting.

• A study by the National Clearinghouse for Education entitled “Do School Facilities Affect Academic Outcomes?” reports appropriate lighting improves test scores and reduces poor behaviour and that daylighting fosters higher student achievement.

Daylighting in Schools, An investigation into the Relationship Between Daylighting and Human Performance. Heschong Mahone Group. “Daylighting in Schools” Report at www.h-m-g.com August 1999.

Actual Experience Shows Benefits of Day Lighting in Schools

A series of schools built in Johnston County, N.C., replaced artificial lights with natural light,

• Schools with daylighting resulted in between 22% and 64% energy savings .
• Students who attended the schools out-performed students in comparable nondaylited schools by 5% to 14%.
• Schools with daylighting witnessed reduced absenteeism among students and achieved 98% average daily attendance

Source: ***U.S. Department of Energy’s Office of Building and Technology, State and Community Programs Report, “Energy-Smart Building Choices: How School Administrators & Board Members Are Improving Learning and Saving Money,” 2002***

Latest Estimates on Better IEQ Benefits

- Fisk and Brunner IEQ in Office Study *

  The estimated benefits of the IEQ scenarios analyzed are substantial in magnitude. The combined potential annual economic benefit of a set of non-overlapping IEQ scenarios is approximately $20 billion.

- Trasande and Liu Environmental Illness in Children Costs Study**

  Poor childhood health caused by environmental factors costs the United States $76.6 Billion in 2008

*See the October 2011 issue of **Indoor Air** from the International Society of Indoor Air Quality and Climate – ISIAQ.

**See the May 2011 issue of Health Affairs

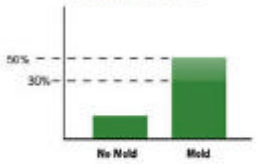
EPA References for Improved Academic Performance, Student Health, and Teacher Retention

Temperature and Humidity

There is evidence that modest changes in room temperature affect student's abilities to perform mental tasks requiring concentration....

Learn More

Asthma Related Health Effects



The presence of dampness and mold increases the risk of asthma and related adverse respiratatory health effects in homes by 30-50 percent.

Learn More

Proactive Maintenance in Schools

Schools without a major maintenance backlog have a higher average daily attendance (ADA) by an average of 4 to 5 students per 1,000 and a lower annual dropout rate by 10 to 13 students per 1,000.

Learn More

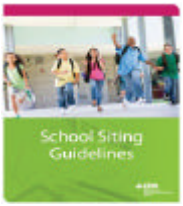
Test scores uniformly increase as building conditions improve.

Test scores can increase by 3 percent to 17 percent.

Sources: http://www.epa.gov/iaq/schools/student_performance/index.html

EPA Guidelines for School Siting and Environmental Health Programs

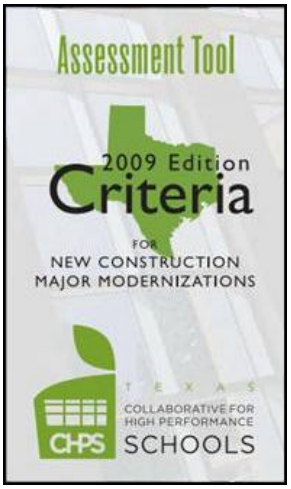
EPA's voluntary School Siting Guidelines encourage consideration of environmental factors in local school siting decision-making processes.
http://www.epa.gov/schools/siting/



EPA's voluntary State K-12 School Environmental Health Program Guidelines provide a framework for improving the health and well-being of students by creating and sustaining healthy, safe, and productive school environments.
ov/schools/ehguidelines/
ehguidelines-draft.pdf

CHPS Assessment Tools for Schools

TX-CHPS ensures that the state's schools have access to appropriate tools and resources to build high performance schools, schools that can improve student and staff health, improve student performance, increase a sense of community, reduce environmental impact, and reduce operating expenses.



http://www.chps.net/dev/Drupal/node/38

Center for Green Schools
USGBC

Local Leaders in Sustainability: Special Report from Sundance,

A National Action Plan for Greening America's Schools

- **The report provides a comprehensive review of the benefits of green schools;**
- **a summary of local, state and federal policy solutions;**
- **leadership profiles of green school advocates; and**
- **case studies from both large cities and small communities.**
- **these resources serve as a roadmap on the journey to green schools.**

http://www.centerforgreenschools.org/docs/USGBC%20Mayors%20Summit%20Report_FINAL.pdf

The Impact of School Buildings on Student Health and Performance

The report is an accessible account of current research connecting school buildings with student health and performance and includes a summary of research needed and how individual groups (teachers and students, design professionals, government agencies, etc.) can help in the effort to draw connections between where students learn and their well being.

http://centerforgreenschools.org/studies.aspx

Additional References on Impacts of Indoor Environments on Human Performance and Productivity

Scientific Findings Resource Bank (IAQ-SFRB) Lawrence Berkeley National Laboratory

Impacts of Building Ventilation on Health and Performance
Indoor Dampness, Biological Contaminants and Health
Indoor Volatile Organic Compounds (VOCs) and Health
Impacts of Indoor Environments on Human Performance and Productivity
Benefits of Improving Indoor Environmental Quality

Source: and http://www.iaqscience.lbl.gov/

National Green Apple Day of Service

http://mygreenapple.org/

National Healthy Schools Day

www.NationalHealthySchoolsDay.org

http://www.healthyschools.org/documents/BTSAB-Research_Studies.doc

Green Schools Symposium Oct 11

The US Green Building Council

Central Texas – Balcones Chapter

Fifth Annual Green School Symposium at AMD Lone Star Campus, Oct 11th in Austin, TX.

Attendees at this event work in or on our Texas Schools from teachers to administrators, facility managers to construction managers, school architects and interior designers.

http://2012greenschoolsymposium.wordpress.com/event-details/

Seventh Biennial Scientific Symposium

How School Environments Affect the Health and Educational Performance of Students

October 25-26, 2012 – Dell Children's Medical Center of Central Texas, Austin

Dell Children's is the first hospital in the world to achieve Platinum certification under the LEED program.

(LEED) Leadership in Energy & Environmental Design

http://cehi.org/2012-symposium/

We Learn Here
and
Where We Learn Matters

http://vimeo.com/46229583